MOORED INSTRUMENT OBSERVATIONS FROM BARROW STRAIT, 2005-2006

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Canadian Data Report of Hydrography and Ocean Sciences

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Les établissements de l'ancien secteur des Sciences et Levés océaniques dans les régions et à l'administration centrale ont cessé de publier leurs diverses séries de rapports en décembre 1981. Vous trouverez dans l'index des publications du volume 38 du *Journal canadien des sciences halieutiques et aquatiques*, la liste de ces publications ainsi que le dernier numéro paru dans chaque catégorie. La nouvelle série a commencé avec la publication du rapport numéro 1 en janvier 1982.

Canadian Data Report of
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by

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Abstract

Pettipas, R., J. Hamilton, and S. Prinsenberg. 2010. Moored instrument observations from Barrow Strait, 2005-2006. Can. Data Rep. Hydrogr. Ocean Sci. 190: vii + 139 p.

Instrumented moorings deployed in the eastern end of Barrow Strait from August 2005 to August 2006 provide yearlong records of current, temperature, salinity, bottom pressure, ice drift and ice thickness, extending a data time series started in August of 1998. The presented current and ice drift data have been collected with acoustic Doppler current profilers (ADCPs) and specialised instrumentation for near-pole direction measurement. Temperature, salinity and density for fixed depths from moored CTDs, bottom pressure and temperature from water level recorders (WLRs), and ice draft from an ice profiling sonar (IPS) are also presented. The current and ctd data are presented as filtered and unfiltered time series, spectral and tidal analyses products, and statistical summaries.

Finally, two CTD sections across Barrow Strait based on a 2006 ship-based survey are presented.

Résumé

Pettipas, R., J. Hamilton, and S. Prinsenberg. 2010. Moored instrument observations from Barrow Strait, 2005-2006. Can. Data Rep. Hydrogr. Ocean Sci. 190: vii + 139 p.

Batteries d'instruments ancrées dans l'embouchure est du détroit de Barrows d'août 2005 à août 2006 ont fourni sur l'année des mesures des courants, de la température, de la salinité, de la pression au fond, de la dérive et de l'épaisseur de la glace, qui viennent prolonger une série chronologique de données commencée en août 1998. Les données sur les courants et la dérive de la glace qui sont présentées ont été recueillies au moyen de profileurs de courant à effet Doppler (ADCP) et d'instruments spécialisés pour la mesure des directions près du pôle. Sont également présentées des données sur la température, la salinité et la densité à des profondeurs fixes mesurées avec des sondes CTP ancrées, des données sur la température et la pression au fond obtenues à l'aide de limnigraphes et des données sur la dérive de la glace obtenues à l'aide d'un

sonar profileur de glace. Les données sur les courants et les données des sondes CTP sont présentées sous forme de séries chronologiques lissées et brutes, de produits issus d'analyses des marées et d'analyses spectrales, et de résumés statistiques.

Enfin, deux coupes transversales d'enregistrements des sondes CTP dans le détroit de Barrows provenant d'un relevé réalisé à partir d'un navire en 2006 sont aussi présentées.

Introduction

A field program to quantify and examine the inter-annual variability of the exchange through Barrow Strait (a principal pathway between the Arctic and North Atlantic Oceans), was started by BIO investigators in August of 1998. Data from the first 7 years of this study, along with a description of the methods used, have previously been reported [Pettipas et al., 2008, 2006, 2005; Hamilton et al., 2008, 2004, 2003, 2002]. Described here are moored instrument data from the eighth year of the study.

Yearlong records of temperature, salinity and density information derived from moored microcat CTD data are presented as unfiltered and low-pass filtered time series, and also as power spectra. Current rate and direction (from ADCPs and custom pole compasses) are also presented as unfiltered and low-pass filtered contour plots, and as time series plots for depths corresponding to the moored CTDs. Seasonally averaged statistical summaries for both the CTD and current data are provided as graphs and/or in tabular form. Results of tidal analyses of the current data give tidal amplitudes, phase, and ellipse orientation as a function of depth for each of the 5 main tidal constituents (K1, M2, O1, S2, P1). Separate tidal analyses have been done for periods of solid ice cover and periods of open water.

Ice drift velocity, obtained from the acoustic Doppler current profilers (ADCPs), are presented as yearlong time series. Ice draft measurements were acquired with a moored ASL ice profiling sonar (IPS), and a statistical summary of these data is presented in graphical form. This is the second year for ice draft measurements. They were also collected at the same location in 2003-2004 (Hamilton et al, 2008). Water level and bottom temperature from water level recorders (WLRs) in 4 locations to provide along and cross-strait slopes are also presented. The Icycler profiler was once again moored on the South side of the strait but stopped working early in the deployment when a connector flooded. The ten near-surface profiles of salinity, temperature, fluorescence and density collected before this failure are shown as contour plots.

Finally, hydrographic sections at the eastern and western ends of Barrow Strait are presented. These cross-sectional diagrams are created from a CTD survey conducted during the field study. A line across Wellington Channel that is usually done was not

attempted this year due to heavy ice conditions there. These CTD lines have been completed each summer since 1998 when ice conditions allowed.

Mooring Locations and Description

Instrumented moorings were distributed over 4 sites across the eastern end of Barrow Strait (Figure 1) as in the previous 4 years, but sensors were combined on these moorings where possible, reducing the total number of moorings along this main line from 10 to 8. Three moorings were located at the 150 m contour on the south side, 3 moorings were halfway between this Southern site and the center of the strait (the "South Central" site), 1 moorings was in the middle of the strait (the Central site), and 1 mooring was at the 200 m contour on the north side. An illustration of the 8 moorings deployed along the main line is shown in Figure 2. A ninth mooring to support a water level recorder was also deployed 95 km to the west (see Figure 1).

ADCPs manufactured by Teledyne RD Instruments and precision heading references (Watson Industries, Inc.) were mounted in streamlined buoyancy packages to provide current rate and direction information. The technique used to obtain reliable direction measurements here, where conventional compass technology is inadequate due to the proximity of the site to the magnetic pole, is described in detail by Hamilton [2004, 2001]. The upward looking ADCPs logged average speeds from 100 pings over a 5 minute on-period every 2 hours, and also provided a simultaneous ice drift speed over the yearlong deployment. 307 KHz Workhorse Sentinel ADCPs were used at the Southern, Central and Northern sites. A "Workhorse Long Ranger" (75 kHz) was used at the South-Central site. Concurrent direction measurements were logged separately with the precision heading reference systems, and have been merged with the ADCP speed data for presentation here. All 5 ADCP/compass systems were successfully recovered with full data sets, although the Long Ranger at the South-Central site did not provide ice drift data due to instrument setup issues.

An IPS was moored at the South-Central site, and provided good quality ice draft data for the duration of the yearlong deployment. Ice draft is the distance between the bottom of the ice and mean sea level.

SeaBird MicroCat CTDs were used to measure temperature, conductivity and pressure at targeted depths of 40, 80 and 160 m across the Strait, as well as the near-bottom at the South-Central site. These CTDs recorded temperature, conductivity and pressure at a single depth every 30 minutes. All 13 microcat CTDs were recovered and returned good data.

Water level recorders were attached to anchors of moorings at the Southern, Central and Northern sites along the main mooring line, in addition to the water level recorder deployed in the middle of the strait south of Resolute. This was the third year that the water level recorders were used in the array but the first year that all returned good pressure data, providing a good data set for quantifying and examining the geostrophic flow through the strait.

The "Icycler" profiler (the prototype Icycler50) was moored at the Southern site to obtain water property information in the upper water column where conventional mooring technology can not be used due to the high risk of loss to ice. Icycler is described in Fowler et al, [2008], and yearlong records at this site from a successful deployment in 2003-2004 are presented in Hamilton et al, 2008.

A summary of the 2005-2006 moorings and instrumentation, including mooring positions, instrument depths and acquired data records, is presented in Table 1.

Data Processing

Current Speed and Direction Data

The 307 kHz ADCPs were mounted in streamlined buoyancy packages (A2 "SUBs" manufactured by Open Seas Inc.) and set up to measure current relative to the instrument axes, ignoring their own compass information. These instruments were set up to average over a depth interval of 4 m. Typically, the highest useful depth average in the data sets from the 3 upper (about 80 m) ADCP instruments was centered around 10 m.

Current data above this level were rejected based on RDI's standard echo intensity quality criterion. These acoustic Doppler current profilers also record ice drift velocity when there is solid or near-solid ice cover.

At the Southern site, two 307 kHz ADCPs at different depths (76 m and 144 m) and separated by 460 m, are combined to provide currents for most of the water column. A comparison of current direction at the 70 m level where the ranges of these 2 instruments overlap indicates that there was a 25° difference in the vector mean current direction. No problem with either ADCP/pole compass combination could be identified, so all data are reported. At the South-Central site where the bottom depth is 264 m, the 75 kHz Long Ranger ADCP moored near bottom provided near full water column coverage with a single instrument. At the Central and Northern sites, currents for the upper water column only are provided by the 307 kHz ADCPs moored at 76 m depth.

Direction was provided using an independent compass package mounted in the buoyancy package tail to give the orientation of the ADCP relative to magnetic north. Initiation of a compass sample cycle was triggered by the commencement of the bihourly ADCP measurement by making use of Teledyne RDI's "RDS3 interface" to provide a turn-on pulse to the compass. The compass was programmed to take a 10 s sample in the middle of the 5 minute ADCP sampling interval. This conserved compass battery power, and took advantage of previous experience that current direction does not change significantly over 5 minutes at the study location [Hamilton et al., 2003]. Direction records were then adjusted for the variation in magnetic declination using magnetic observatory data from the NRCAN observatory in Resolute to get direction relative to true north.

Vertical excursions of the ADCPs caused by current drag forces acting on the mooring were similar to previous years, rarely exceeding 2 meters.

Moored CTD Data

SeaBird MicroCat CTDs were set up to measure temperature, conductivity and pressure every 30 minutes for the yearlong deployments. The mooring supporting the 40 m level CTD at the South-Central site was subjected to the greatest dip due to current

drag forces acting on the mooring. The largest observed dip was 9 m, with a standard deviation in instrument depth over the yearlong deployment of just 0.8 m.

Low-Pass Filtering

Some of the data series presented have been filtered to remove the semidiurnal and diurnal tides using the technique described by Godin (1972). The technique uses three simple averaging filters applied in sequence. Godin, working with hourly observations, recommends two consecutive applications of a filter that averages over 24 samples, followed by one that averages over 25 samples. Here for the bi-hourly current data, we sequentially apply 12,12, and 13 sample averaging filters, while for the semi-hourly MicroCat CTD data we sequentially apply 48, 48 and 50 sample averaging filters.

Tidal Analysis

Harmonic tidal analyses of current data using Foreman's (1978) method is presented separately for a period of solid ice cover (23 weeks), and a period of broken or no ice (8 weeks). These ice conditions are similar to those seen the previous year (2004-2005) and the earlier years of the study (1998-2002) when ice was land fast for at least 4 months each winter at all ADCP stations. Years 2002-2003 and 2003-2004 were more anomalous, as ice was far more mobile through the winters, limiting or preventing tidal analysis for the solid ice case. Tidal ellipse axes amplitudes, orientations and phases for the main tidal constituents (K1, M2, O1, P1 and S2) are plotted as a function of depth.

The periodic vector function describing a particular constituent, traces an ellipse over a tidal cycle with major and minor amplitudes defined by the length of the semi-major and semi-minor axes. The major axis amplitude is always positive. The sign of the minor axis amplitude defines the rotation sense of the current ellipse. When positive the vector traces the ellipse in a counter-clockwise direction; when negative, the rotation sense is clockwise.

Ellipse orientation is the angle measured counter-clockwise from east to the semi-major axis.

The phase is a measure of the timing of high water referenced to astronomic positions over the Greenwich meridian. Phase is measured counter-clockwise from this chosen reference.

Data Presentation

Yearlong time series of half-hourly sampled temperature, salinity and density from the moored CTDs are shown in Figures 3 - 6. At the Southern site, the expected freshening we see at the 40m level due to summer melting is evident from the deployment in August through to mid-January. At the South-Central and Central sites, the freshening does not develop until the first of November, but persists into January as at the Southern site.

Power spectra of the moored CTD measurements are shown in Figures 7-10. Results are similar to the previous year. Diurnal and weaker semi-diurnal signals are typically observed in the records, except at the Central site where the spectra show little in the way of distinguishing features.

Current data are shown as contour plots in Figures 11-18. Data are presented in along-strait and cross-strait components, where positive values are defined as flow towards 105° true and 15° true, respectively. Data from the deep and mid-water ADCPs at the Southern site which were moored ½ km apart have been combined in Figure 11. The discontinuity in the cross-strait component of this figure occurring at the 72 m level where the data source transitions from the deeper to upper ADCP, is larger than seen in previous years suggesting an instrumentation problem. Rates measured by the 2 ADCPs through the depth overlap interval compare well indicating the discrepancy is possibly related to disagreement between the pole compasses. However, neither post-deployment compass calibrations nor data analyses could point to either instrument as a source of the discrepancy so all data are reported as valid. The discontinuity does not show up in the along-strait component, which of course is typified by much higher current speeds.

Figures 11-14 display a month of unsmoothed data in which a strong tidal signal is apparent. Low-pass filtered data (tides removed) are shown in Figures 15-18. Mean flow is predominantly eastward at the South, South-central and Central sites throughout the year, and near-zero or weakly westward on the North side, repeating the pattern of the previous 4 years.

Missing data near the surface through the winter and spring (Figures 15, 17) are caused by a decrease in the effective range of the ADCPs when the water is at its clearest, and contains a minimum of acoustic reflectors. (The manufacturer's suggested data quality acceptance criteria have been applied.) The smoothing method used has smeared the impact of missing raw data over the filter length.

Data from the Icycler profiler are shown in Figure 19. Ten daily profiles of salinity, temperature, fluorescence and density are presented as contour plots. Although the data returned by this instrument are very limited due to its early malfunction, the fluorescence record indicates a mid-August phytoplankton bloom as was seen in each of the 2 previous years (Hamilton et al., 2008, Pettipas et. al, 2008).

Smoothed temperature, salinity and current data (where available) are shown for each moored CTD level in Figures 20-32. Tables 2 through 25 provide a summary of the CTD and ADCP data at the CTD depths, with statistics computed over each season, and for the entire year. Density has been included in these statistical summaries.

Annual and seasonal mean flows are summarised in Figures 33-38. Each 4 m binned value for the 307 kHz ADCPs (8 m for the 75 kHz ADCP) is shown. Seasonal current patterns are similar to the previous years, although late summer (2005) currents in the top 100 m at the South-Central are weaker (50 to 75% less) than in each of the previous 3 early summer seasons. Another noticeable difference is seen at the Central site in early summer of 2006 when the mean current is about 10 cm/s eastward over the top 80 of the water column, compared to the previous 2 early summers when currents were near zero. The yearlong averages at all 4 sites however, are quite similar to previous years.

As in the previous 4 years there is significant seasonal variation but mean flow is predominately eastward, and strongest at the Southern site becoming progressively

weaker moving north to the South Central and Central sites, and near-zero or westward on the North side.

The variance in the bi-hourly, and low-pass filtered current data for the yearlong ADCP records are shown in Figure 39. On the south side, tides account for only half of the total variance in the along-strait current speeds. At the South-Central site, tides account for ¾ of the variance near the surface to virtually all of the variance near bottom. A peak in the variance of the bi-hourly data at 215m at this South-Central site suggests the possibility of bottom-trapped shelf waves (Pettipas et al, 2008).

Tidal analysis results for the ADCP data collected at all 4 sites are presented as profiles for the 5 largest tidal constituents in figures 40 – 59. Separate analyses have been done for ice-free and solid ice periods. Ellipse orientations are generally along-strait as expected. Tidal constants are summarised in Tables 26 - 30.

Ice velocities through the year at the 4 sites were derived from the upper ADCPs, and are shown in Figures 60 - 63. No data were returned for the 75 kHz ADCP at the South-Central Site because of an instrument setup issue. Since the ice drift measurement quality is degraded by the presence of open water, there are periods in the time series at all 3 of the other sites where no data are presented. The manufacturer's suggested data quality standards have been applied to the ice drift data. An additional criterion applied here is that where the magnitude of the "error velocity" for a particular ensemble is greater than 1 cm/s, the ice drift velocity estimate and the adjacent estimates are rejected.

Ice was landfast right across the strait from late January through to early July, repeating the pattern of the previous year (04-05). In 2002-2003 and 2003-2004 ice remained mobile throughout the winter at all but the Southern site, but these 2 years appear to be anomalous since in the 4 years prior to that (1998-2002) an extended landfast period similar to this year was observed.

Ice draft was measured at the South-Central site for only the second time in this program, the first year being 2003-2004. Monthly mean, standard deviation, and maximum ice draft for 2005-2006 are shown in Figure 64 and Table 31, while histograms of draft distribution by month (based on the data presented in Table 32), are shown in Figure 65. Over the February to May period in Figure 64, the growth rate of the immobile ice can be seen in the increasing monthly mean draft.

In 2005-2006 ice was immobile for over 5 months, while in 2003-2004 the ice remained in motion throughout the winter. Ignoring months when open water dominates, we find the mean draft over 8 months in 2005-2006 (1.05 m) is 40% lower than in 2003-2004, suggesting that rafting of ice in a mobile ice pack builds ice volume. The very low standard deviations from February to June, 2006 are expected for a landfast ice pack, and were not observed in 2003-2004.

A station map for the August 2006 ship-based CTD survey is shown in Figure 66. Three lines were intended, but the Wellington Channel line (stations 18-23) was not attempted due to heavy ice conditions. Results for the 2 Barrow Strait lines appear as contoured sections in Figures 67 and 68 and indicate an eastward geostrophic flow along the southern half of the Strait as the August survey typically reveals.

Anchor-mounted water level recorders were deployed at the South, Central and North sites of the Barrow Strait mooring line (at approximately 91 °W). Time series plots of pressure and temperature from these instruments are shown in Figures 69, 70 and 71, with statistical summaries provided in Tables 33, 34 and 35. The pressure records from these 3 units will be used to compute the geostrophic current. A fourth water level recorder was deployed on a separate mooring in the center of the strait 95 km to the west of the Eastern Barrow Strait mooring line (Figure 72, Table 36), to provide along-strait surface slope for interpretation of the geostrophic calculations obtained from the water level recorders along the main mooring line. Although the identical array of water level recorders was deployed in each of the two previous seasons, this is the first year when all four instruments were recovered with high quality data sets.

Acknowledgements

We thank Adam Drozdowski and Kumiko Azetsu-Scott for their reviews of this report, and Lorne McKee (NRCAN) for providing the Resolute Observatory magnetic declination data.

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References

Foreman, M.G.G., 1978. *Manual for tidal currents analysis and prediction*. Pacific Marine Science Report 78-6. Institute of Ocean Sciences, Sidney, B.C., 70pp.

Fowler, G.A., G.R. Siddall and S.J. Prinsenberg, 2004. *An energy-conserving oceanographic profiler for use under mobile ice cover: ICYCLER.* International Journal of Offshore and Polar Eng., Vol. 14(3), pp 176 – 181.

Godin, G, 1972. *The Analysis of Tides*. Liverpool: Liverpool University Press, 264pp.

Hamilton, J.M. 2004. *Accurate current directions from instrumented arctic moorings, in* Arctic/SubArctic Ocean Fluxes Newsletter, issue 2, 8-11

Hamilton, J., R. Pettipas and S. Prinsenberg. 2008. Moored current meter and CTD observations from Barrow Strait, 2003-2004. Can. Data Rep. Hydrogr. Ocean Sci. 173 : vi + 134 p.

Hamilton, J., S. Prinsenberg and L. Malloch. 2004. Moored current meter and CTD observations from Barrow Strait, 2000-2001. Can. Data Rep. Hydrogr. Ocean Sci. 165 : v + 59 p.

Hamilton, J., S. Prinsenberg and L. Malloch. 2003. Moored current meter and CTD observations from Barrow Strait, 1999-2000. Can. Data Rep. Hydrogr. Ocean Sci. 161 : v + 60 p.

Hamilton, J., S. Prinsenberg and L. Malloch. 2002. Moored current meter and CTD observations from Barrow Strait, 1998-1999. Can. Data Rep. Hydrogr. Ocean Sci. 157 : v + 65 p.

Hamilton, J. M., 2001. Accurate Ocean Current Direction Measurements Near the Magnetic Poles, in *Proceedings of the Eleventh (2001) International Offshore and Polar Engineering Conference*, 656-660. ISOPE: Stavanger, Norway.

Pettipas, R., J. Hamilton, and S. Prinsenberg. 2008. Moored current meter and CTD observations from Barrow Strait, 2004-2005. Can. Data Rep. Hydrogr. Ocean Sci. 174 : vi + 135 p.

Pettipas, R., J. Hamilton and S. Prinsenberg. 2006. Moored current meter and CTD observations from Barrow Strait, 2002-2003. Can. Data Rep. Hydrogr. Ocean Sci. 167 : v + 118 p.

Pettipas, R., J. Hamilton and S. Prinsenberg. 2005. Moored current meter and CTD observations from Barrow Strait, 2001--2002. Can. Data Rep. Hydrogr. Ocean Sci. 166 : v + 118 p.

Prinsenberg, S, R. Pettipas, G.A. Fowler, G. Siddall, 2007. The ups and downs in developing an under-ice moored profiler called the Icycler, *in Proceedings of the 17th (2007) International Offshore and Polar Engineering Conference,* 730-734, ISOPE: Lisbon Portugal.

Figure 1 **A map of the work area showing the location of the mooring sites (the open boxes), and the hydrographic survey lines (the dashed lines)**

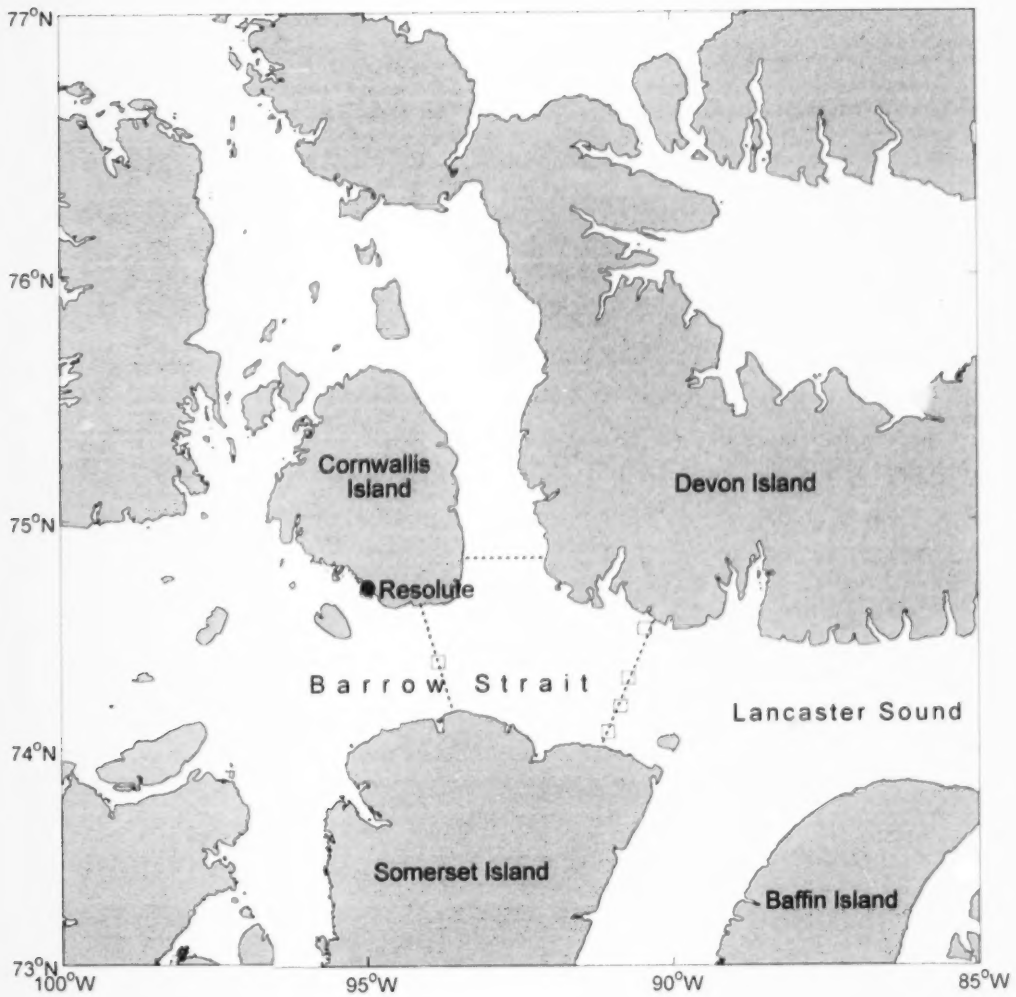


Figure 2 **Illustration of the instrumented moorings across eastern Barrow Strait.**

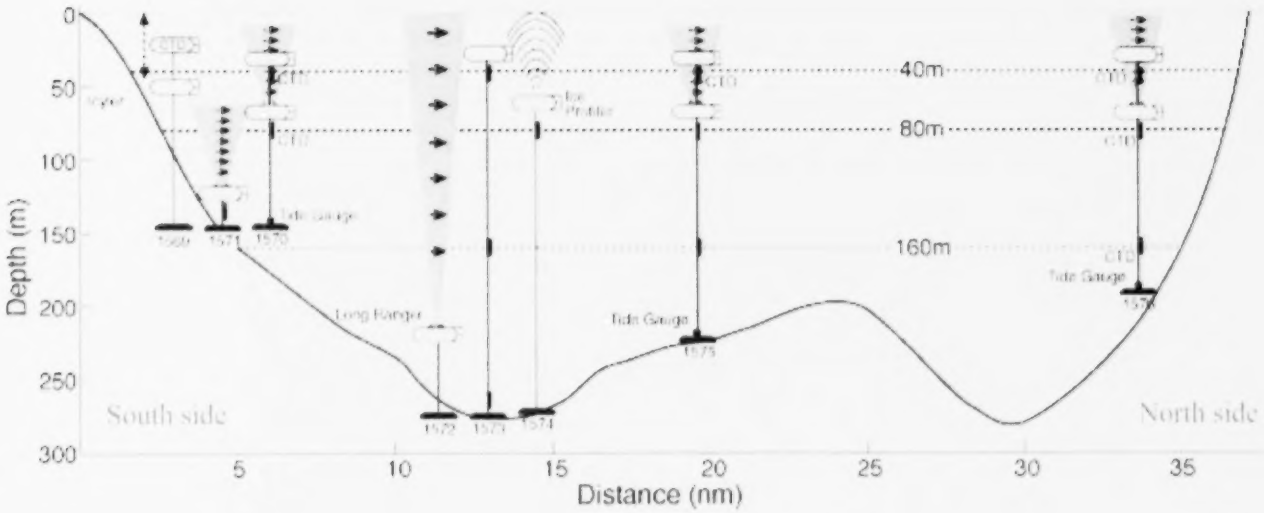


Figure 3 – Moored 30 min. CTD data, South Side Barrow Strait. August 2005 – July 2006

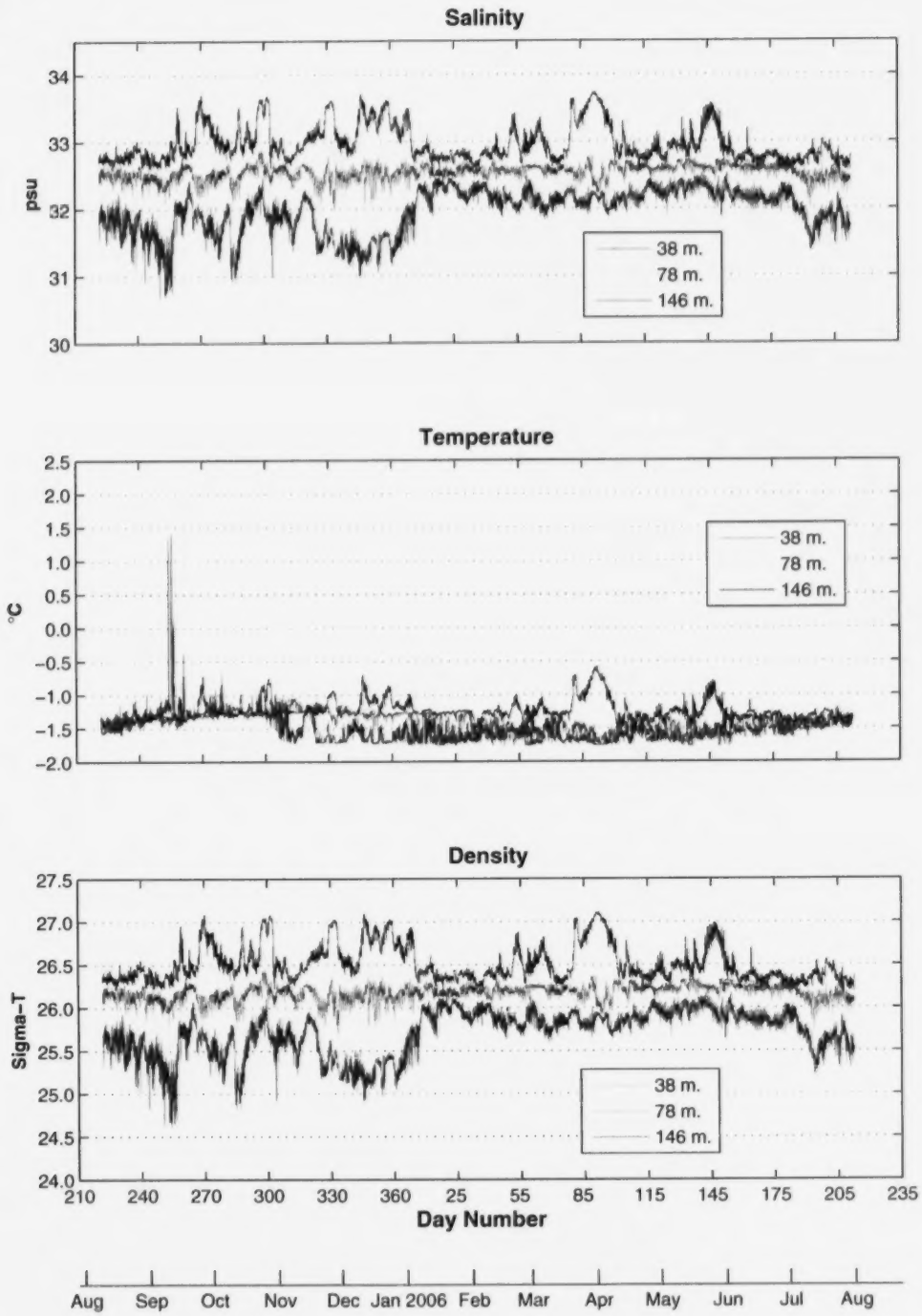


Figure 4 - Moored 30 min. CTD data, South Central Barrow Strait. August 2005 – July 2006

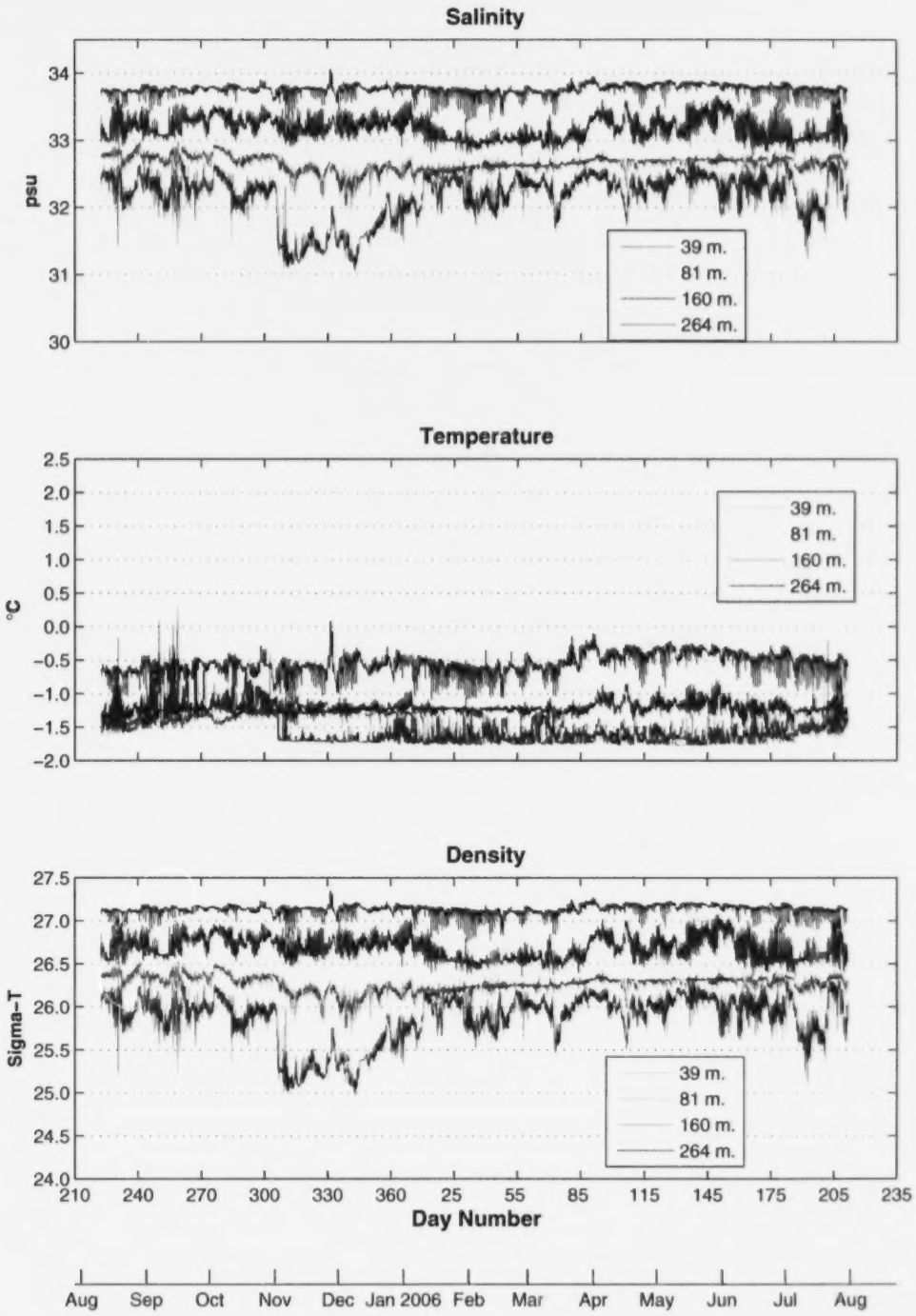


Figure 5 – Moored 30 min. CTD data, Central Barrow Strait.
August 2005 - July 2006

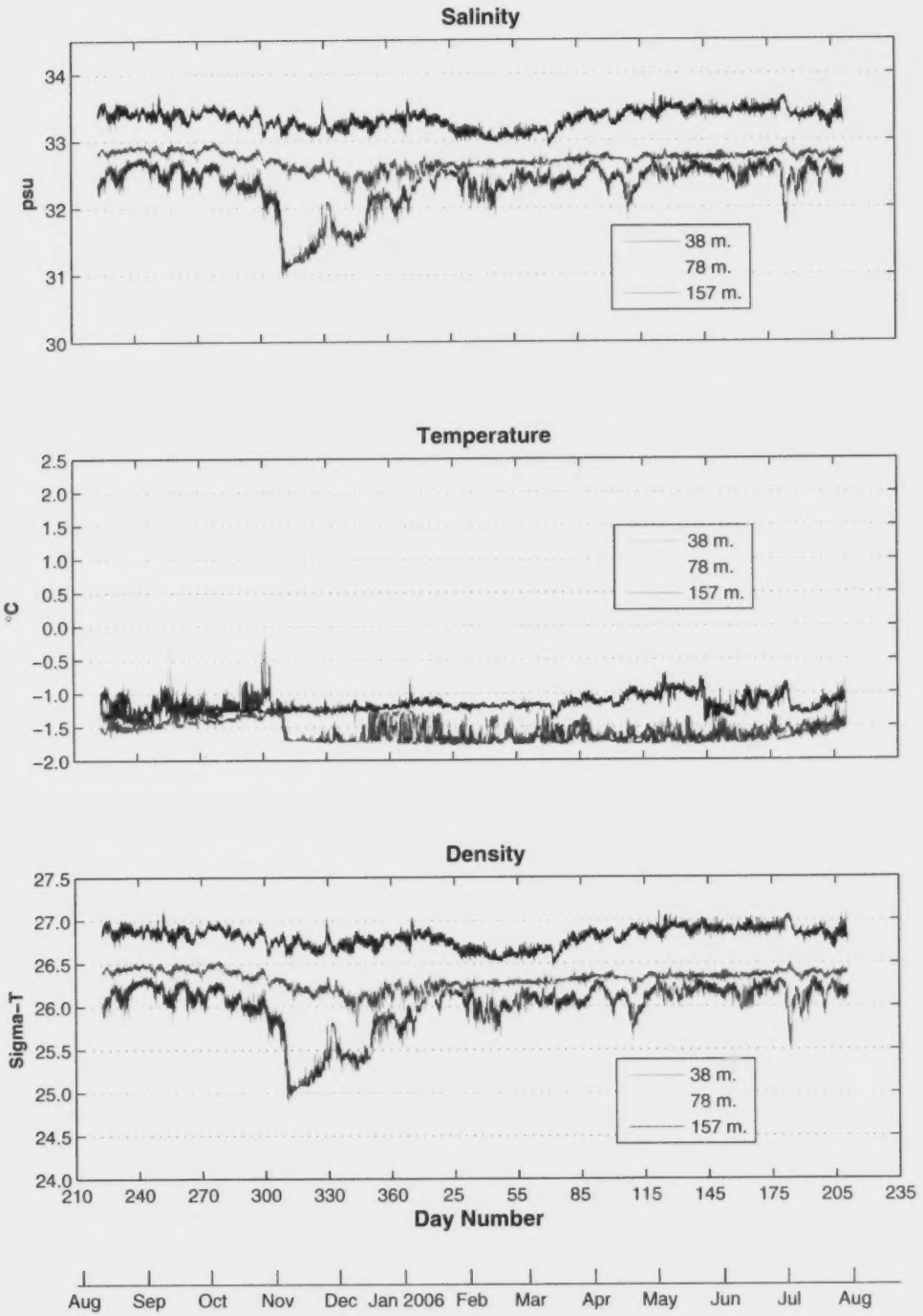


Figure 6 - Moored 30 min. CTD data, North Side Barrow Strait.
August 2005 – July 2006

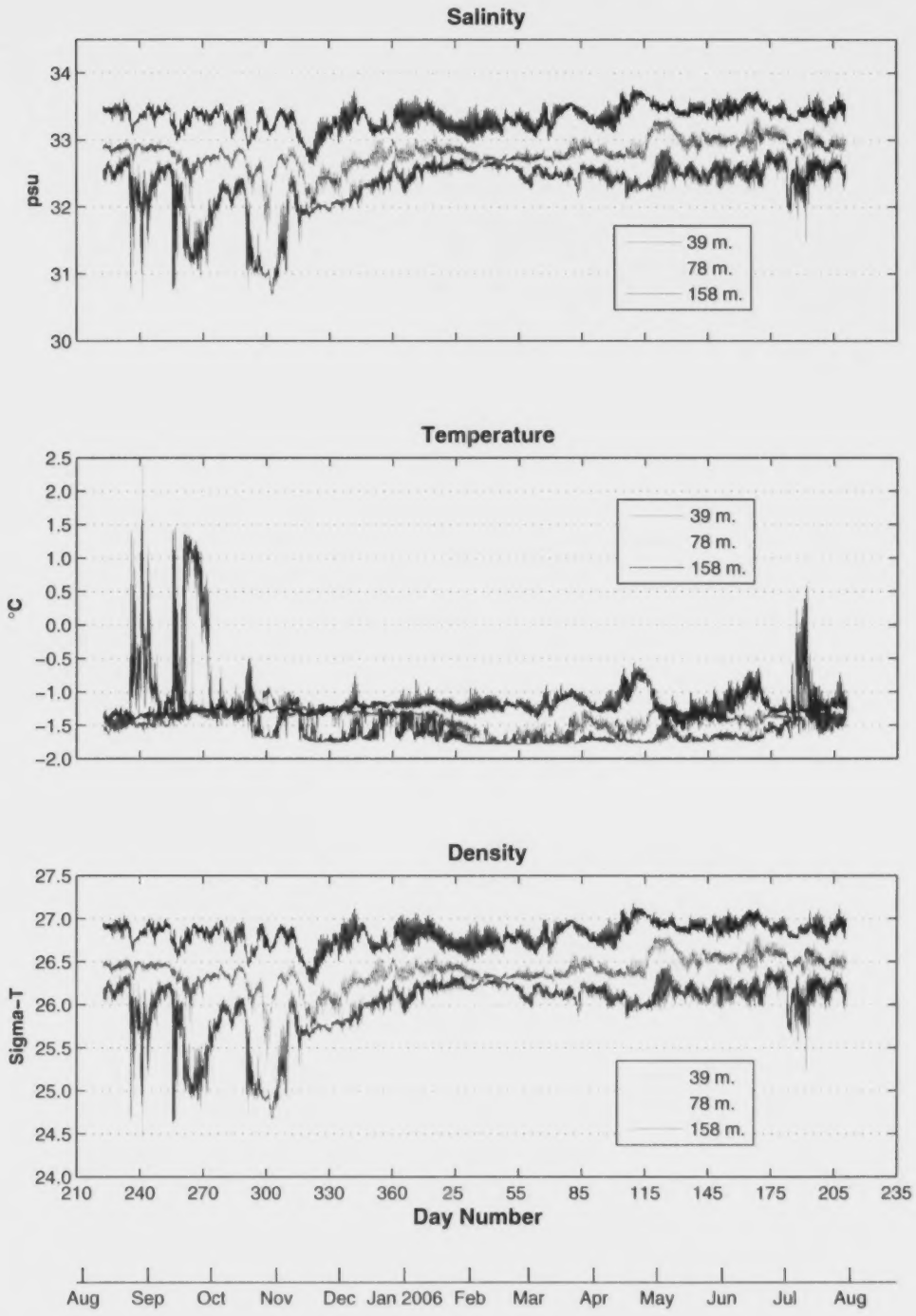


Figure 7 – Power Spectra of moored bi-hourly CTD data. South Side Barrow Strait: Aug. 2005 – July 2006.

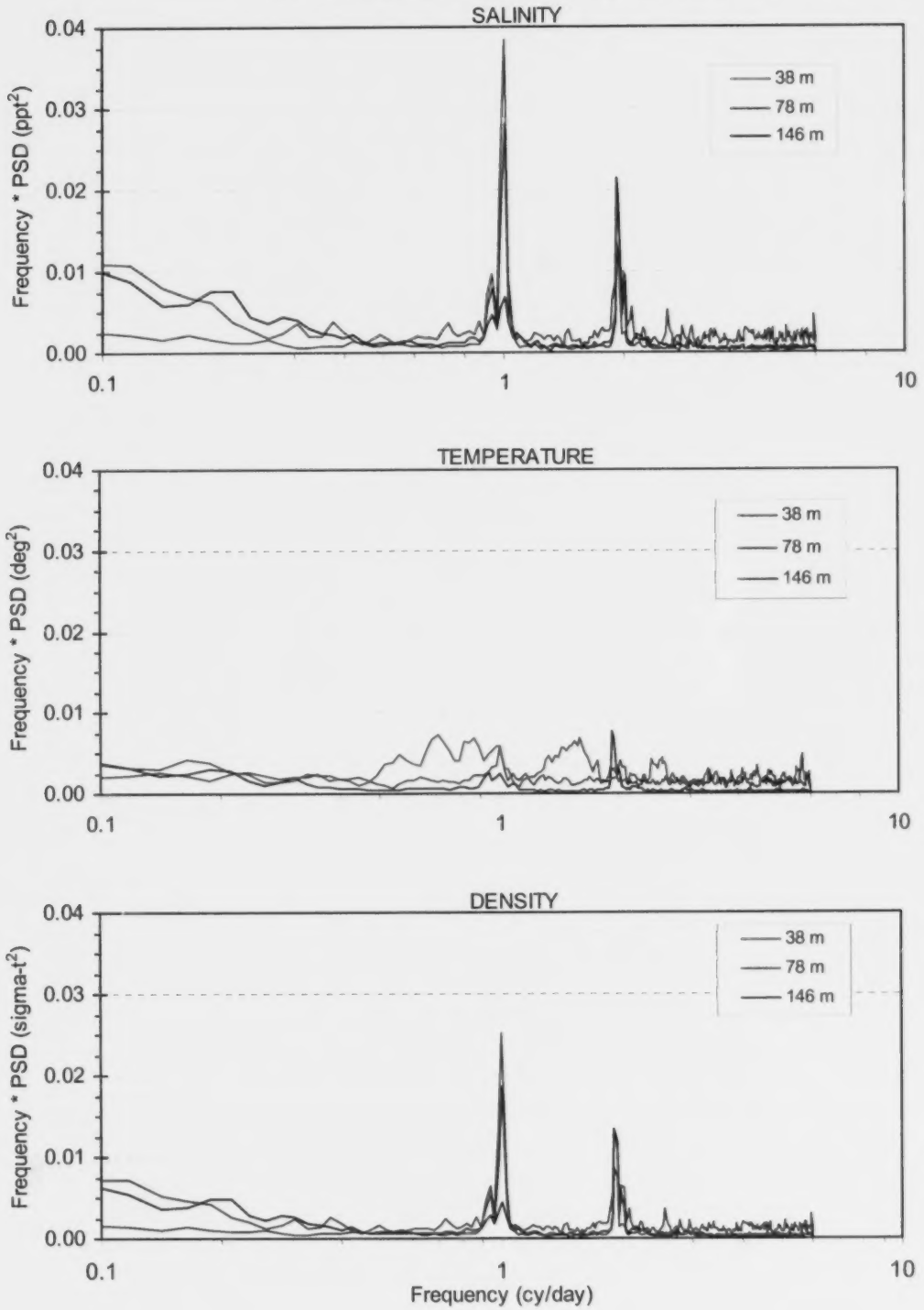


Figure 8 – Power Spectra of moored bi-hourly CTD data.
South Central Barrow Strait: Aug. 2005 – July 2006.

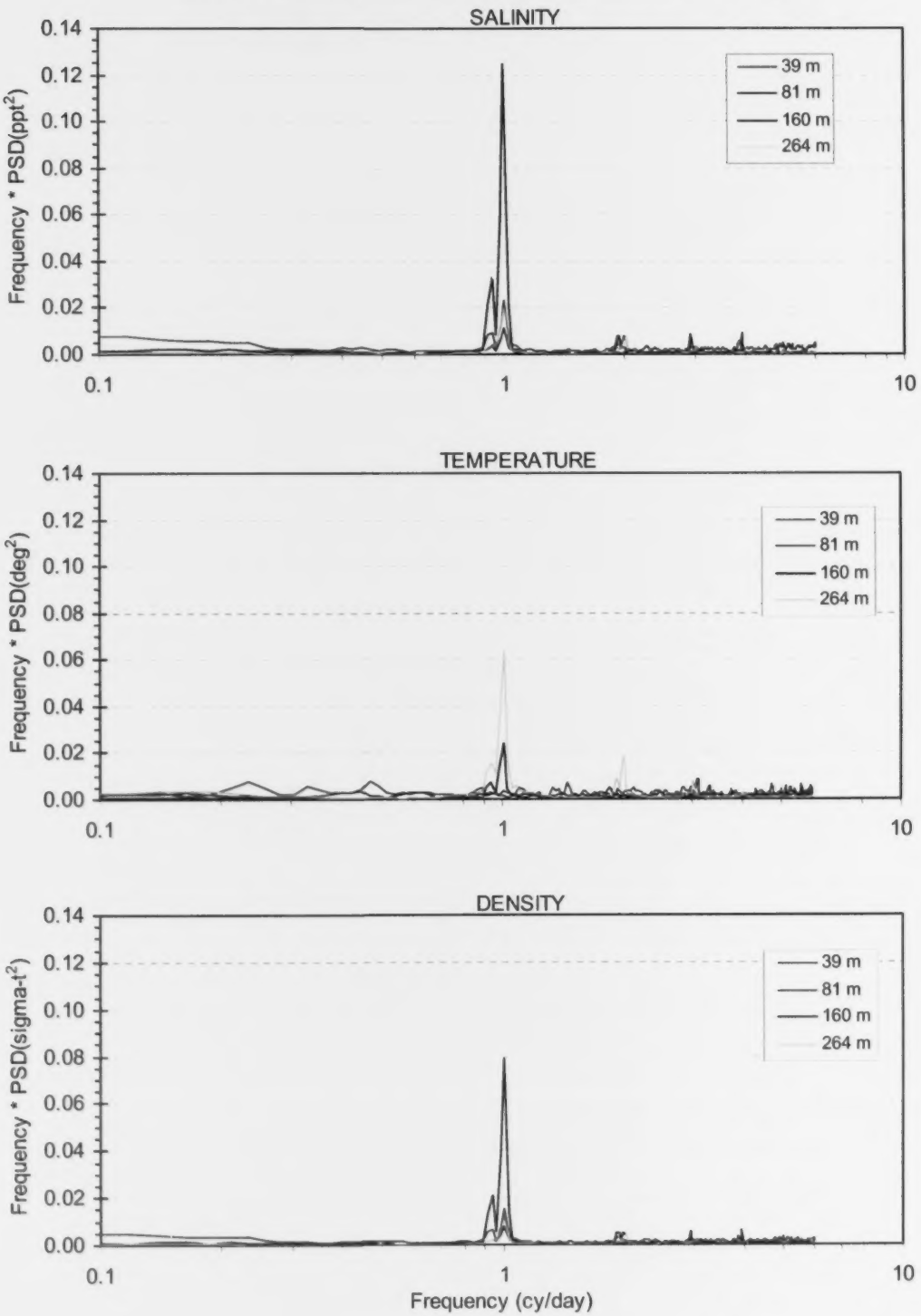


Figure 9 - Power Spectra of moored bi-hourly CTD data. Central Barrow Strait: Aug. 2005 – July 2006.

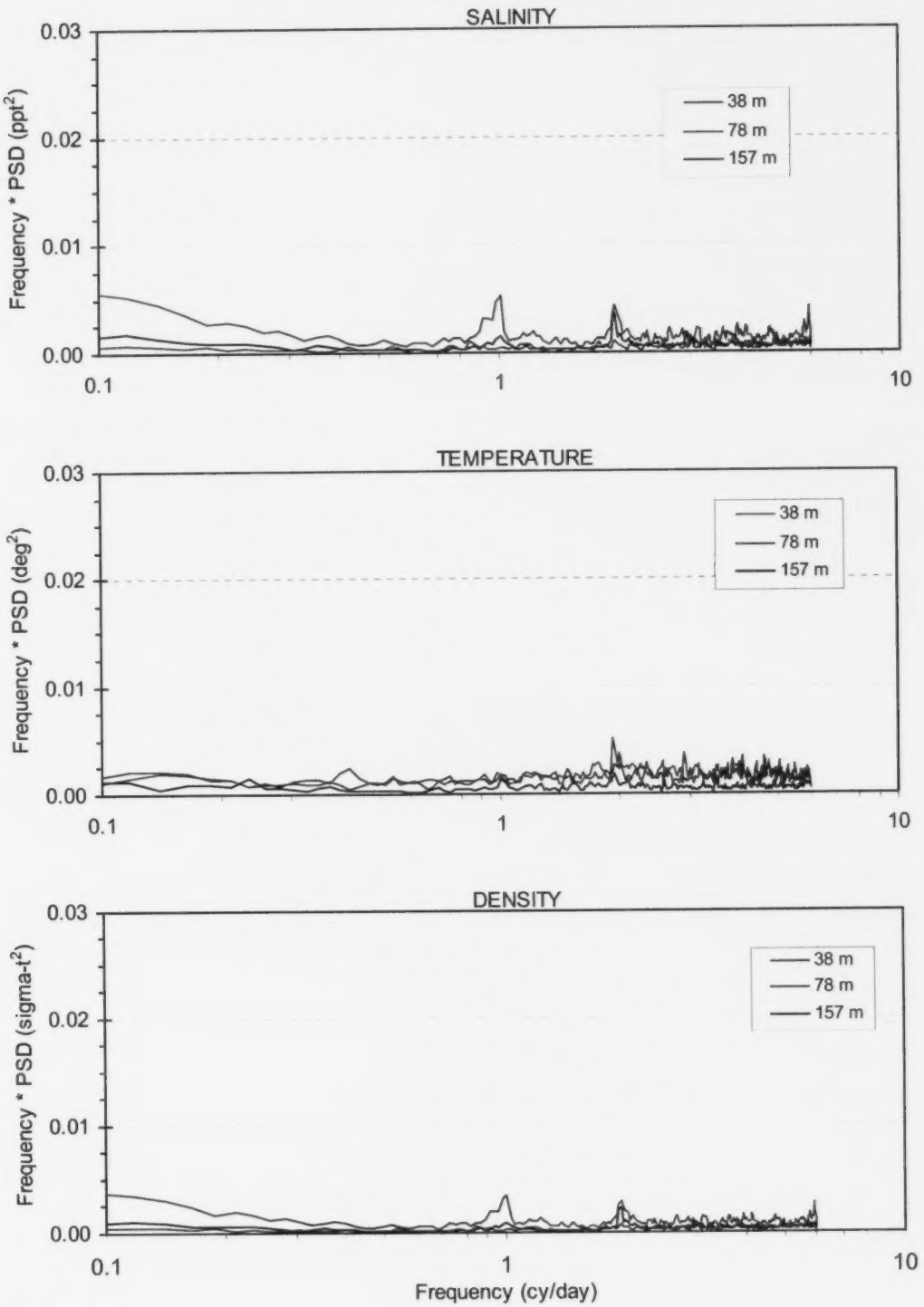


Figure 10 – Power Spectra of moored bi-hourly CTD data. North Barrow Strait: Aug. 2005 – July. 2006.

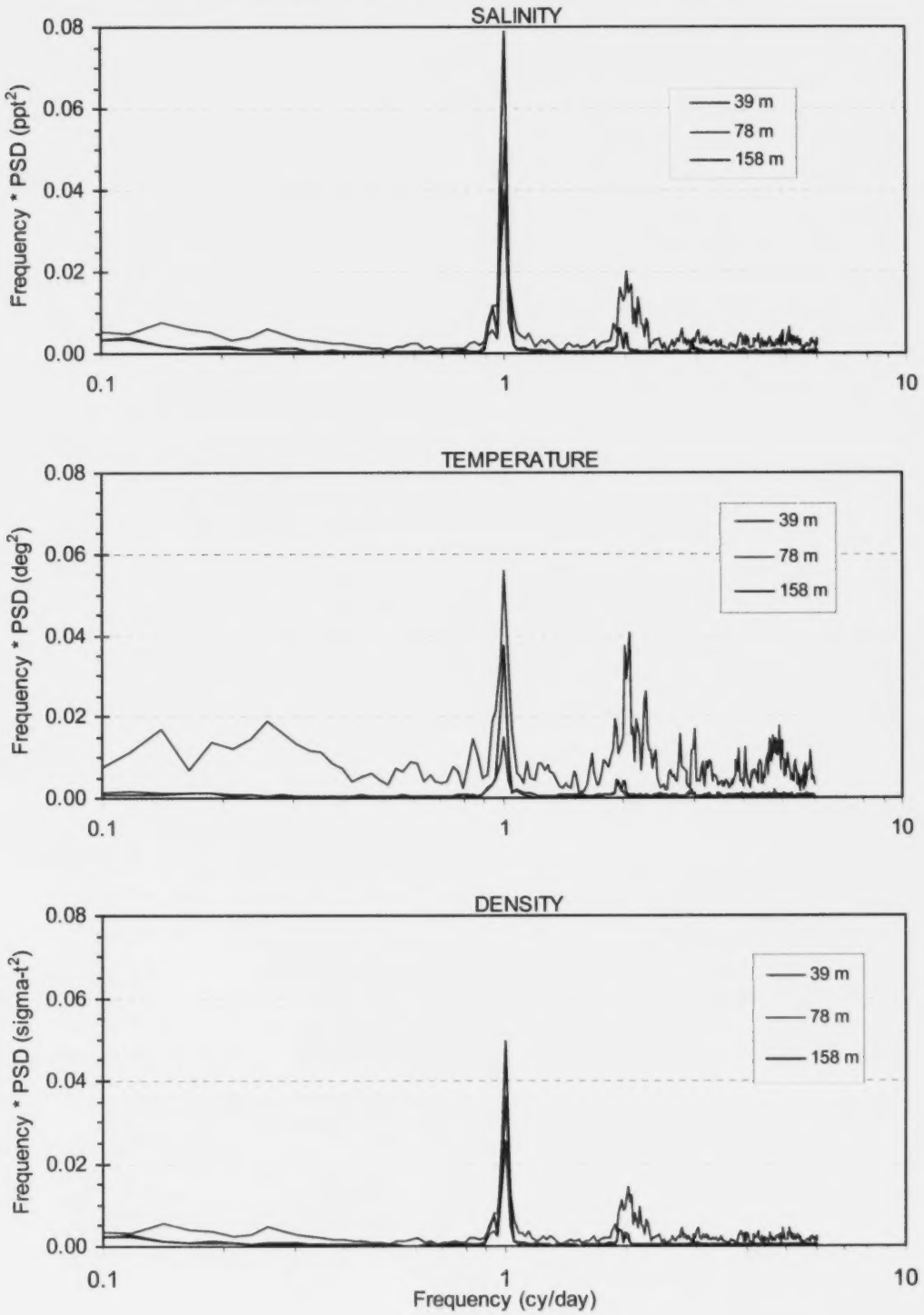


Figure 11 – Bi-hourly current data, South Side Barrow Strait.
Sep. 1, 2005 – Sep. 30, 2005

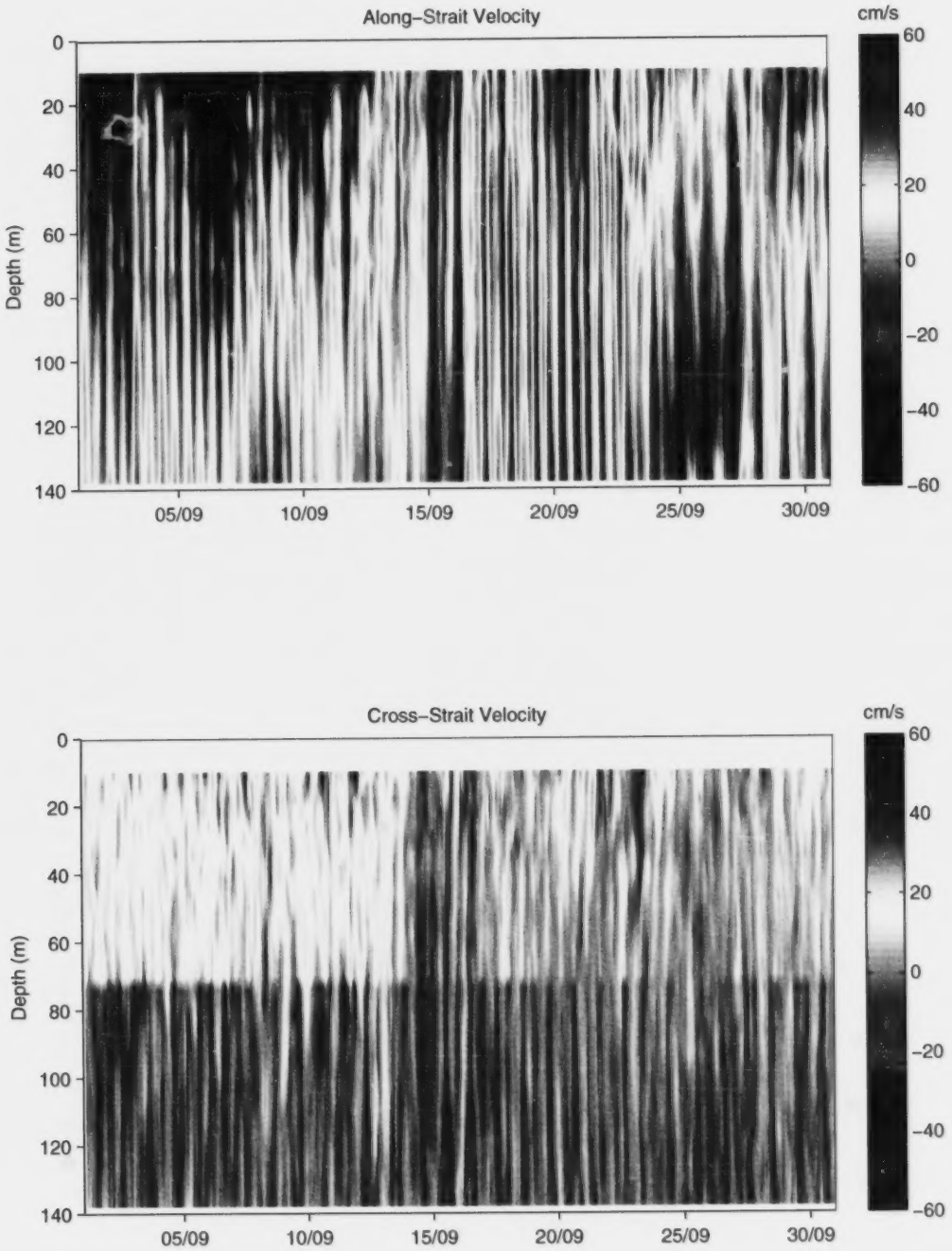


Figure 12 – Bi-hourly current data, South Central Barrow Strait.
Sep. 1, 2005 – Sep. 30, 2005

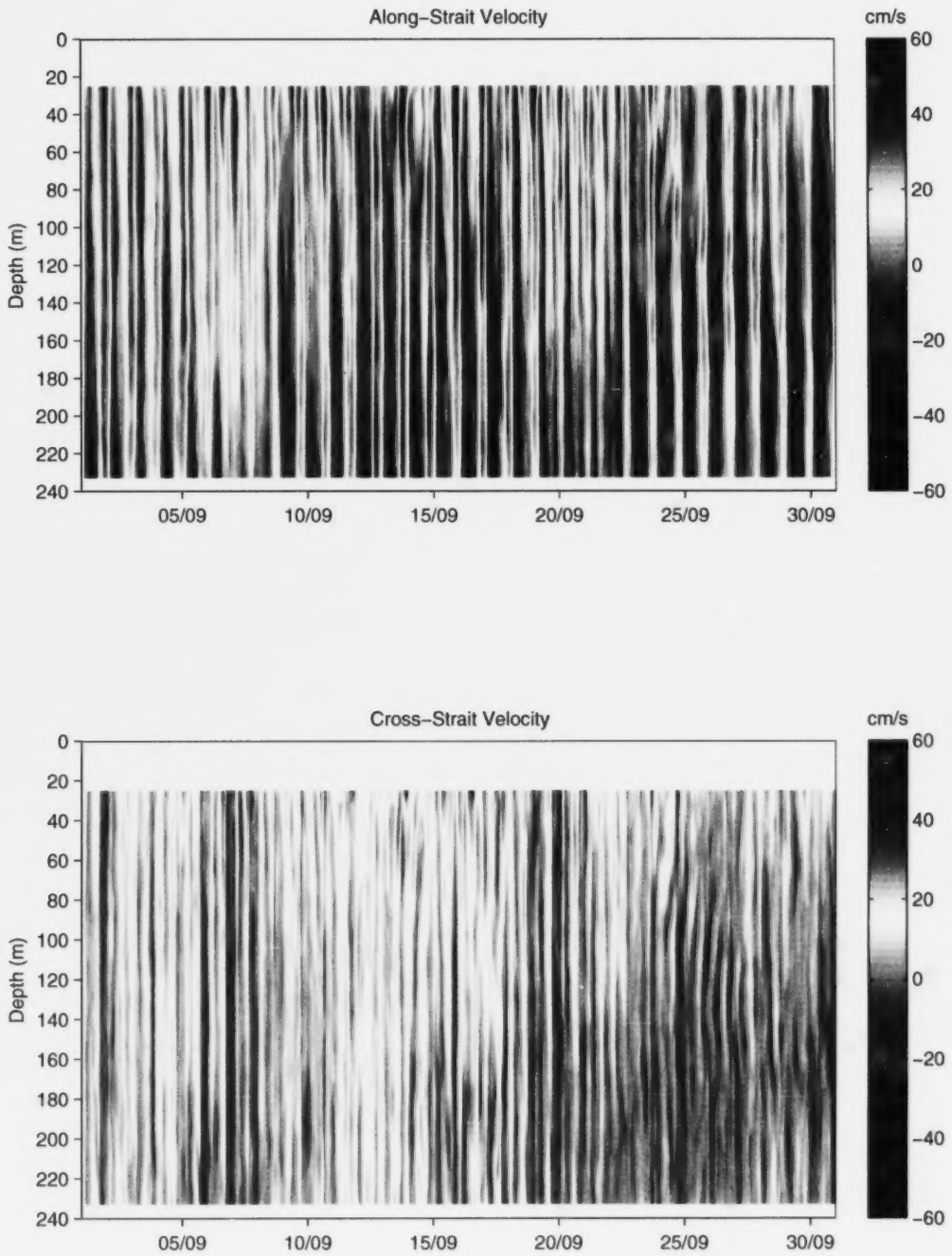


Figure 13 – Bi-hourly current data, Central Barrow Strait.
Sep. 1, 2005 – Sep. 30, 2005

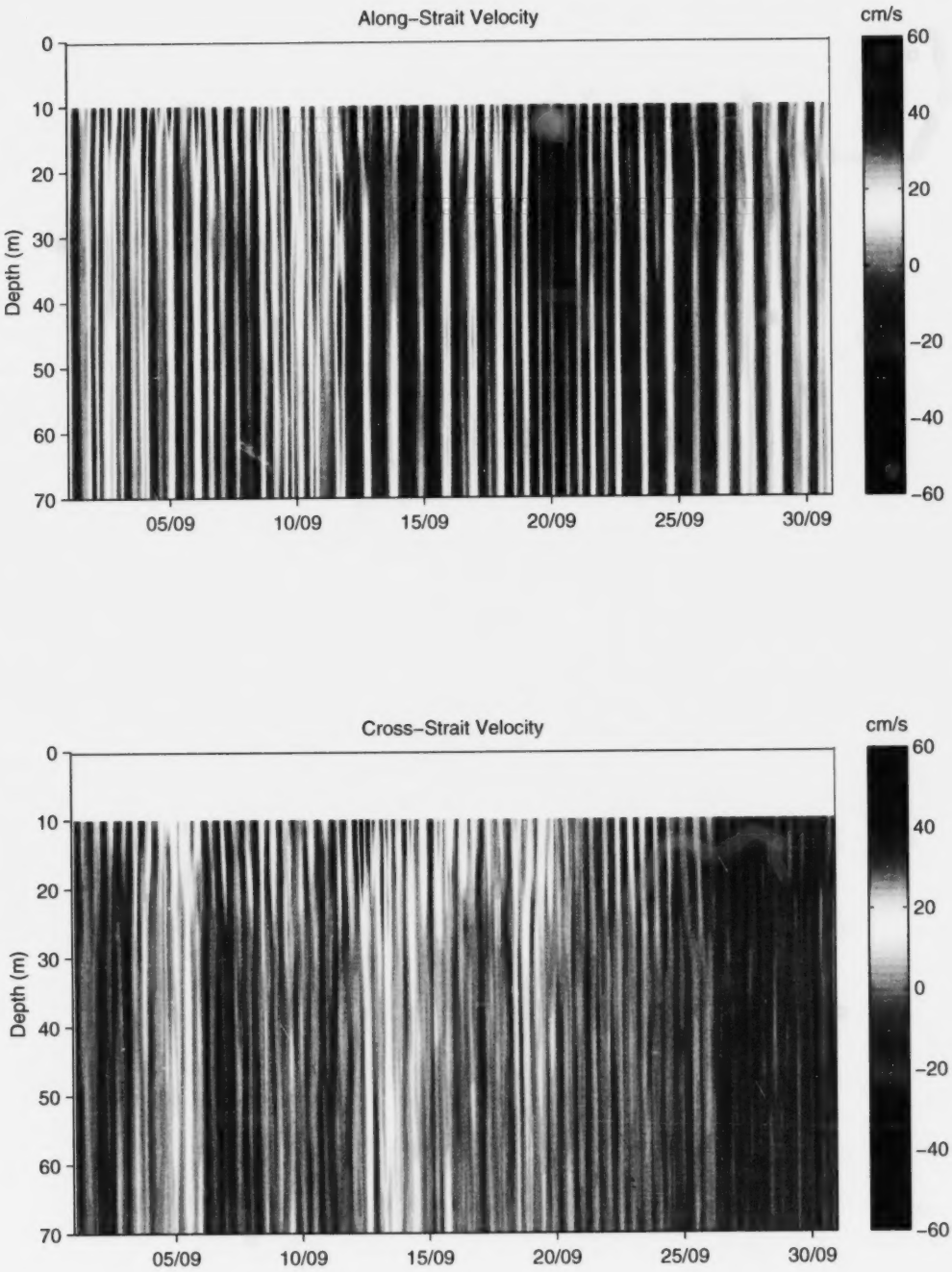
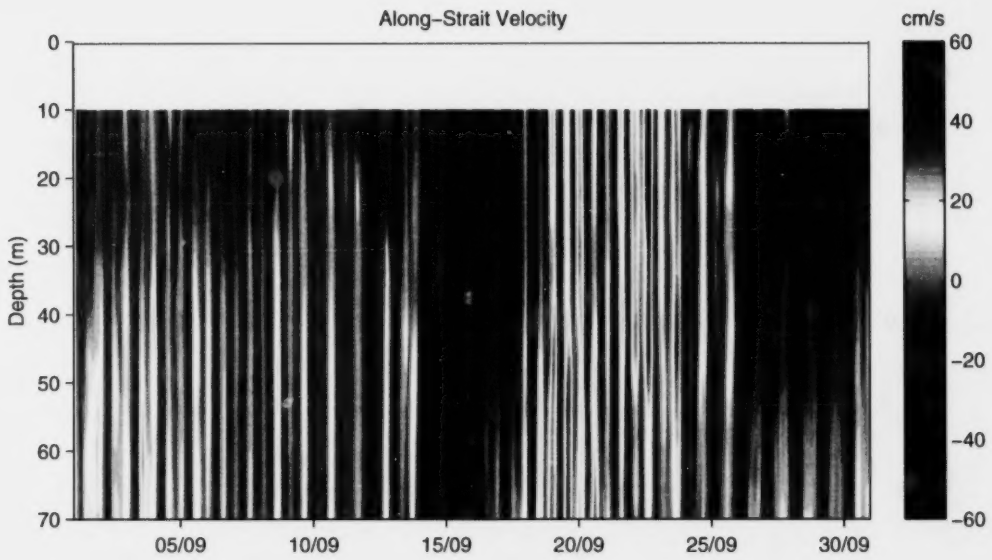


Figure 14 – Bi-hourly current data, North Side Barrow Strait.
Sep. 1, 2005 – Sep. 30, 2005



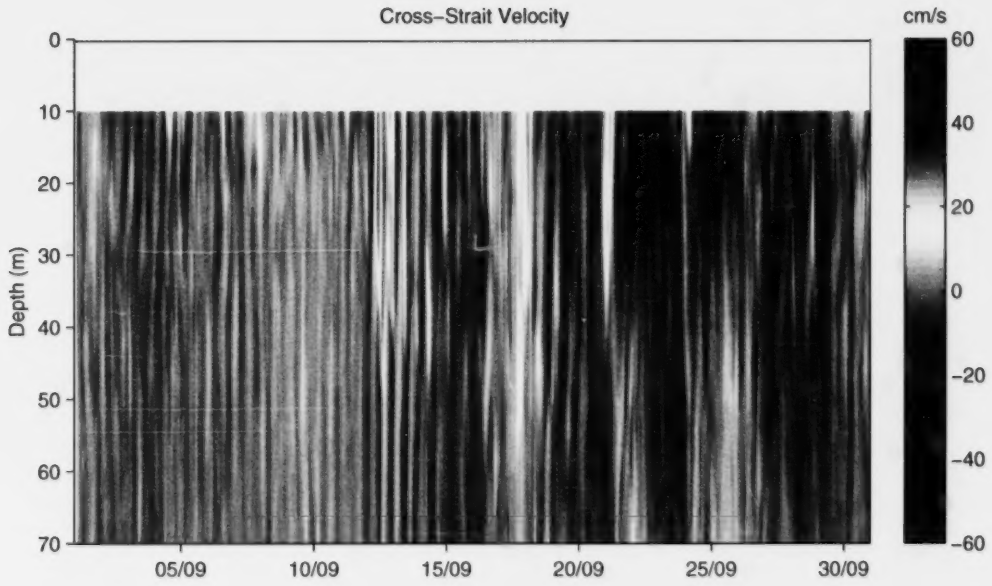


Figure 15 - Low-pass filtered currents, South Side Barrow Strait. August 2005 – July 2006

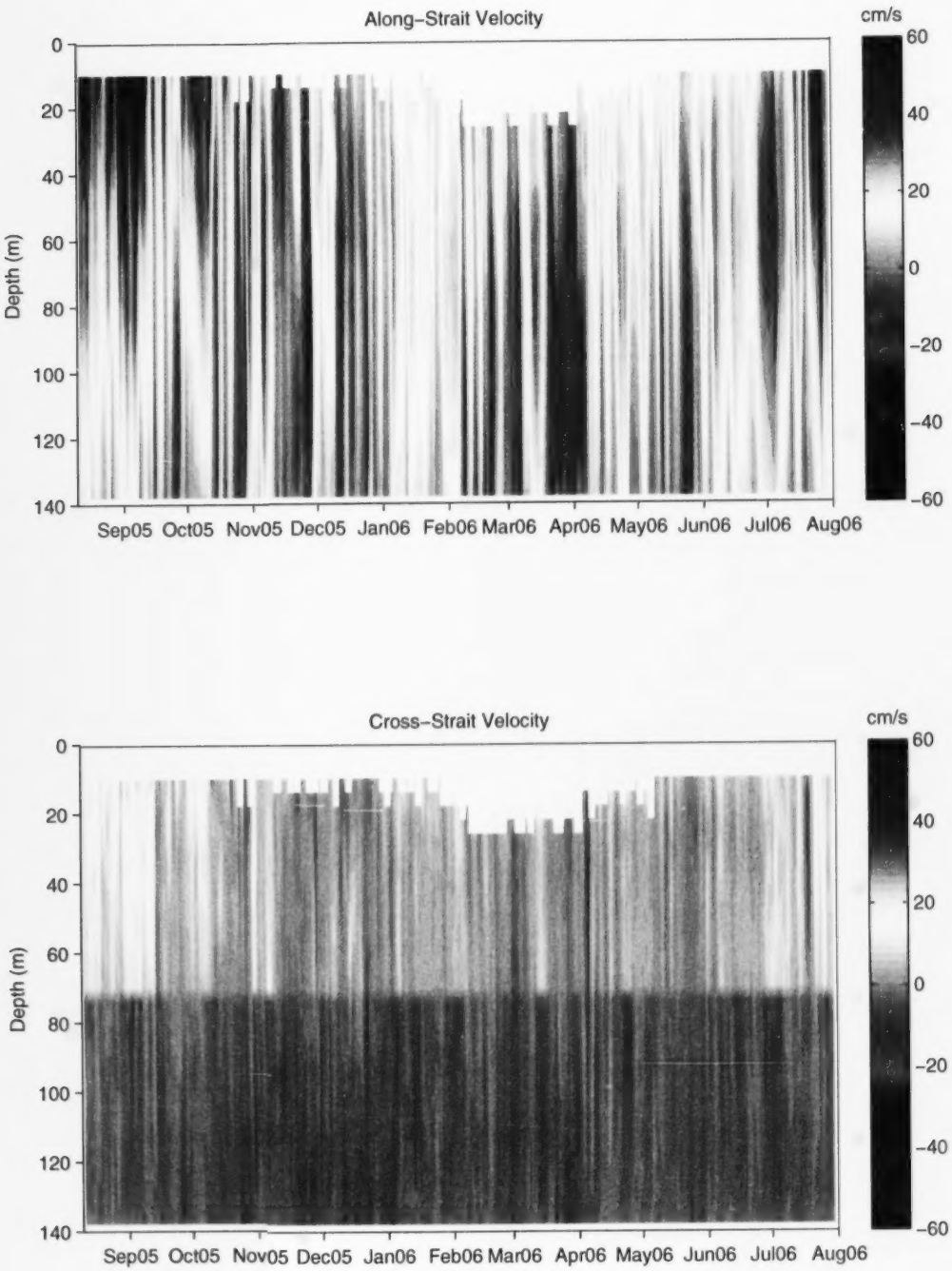
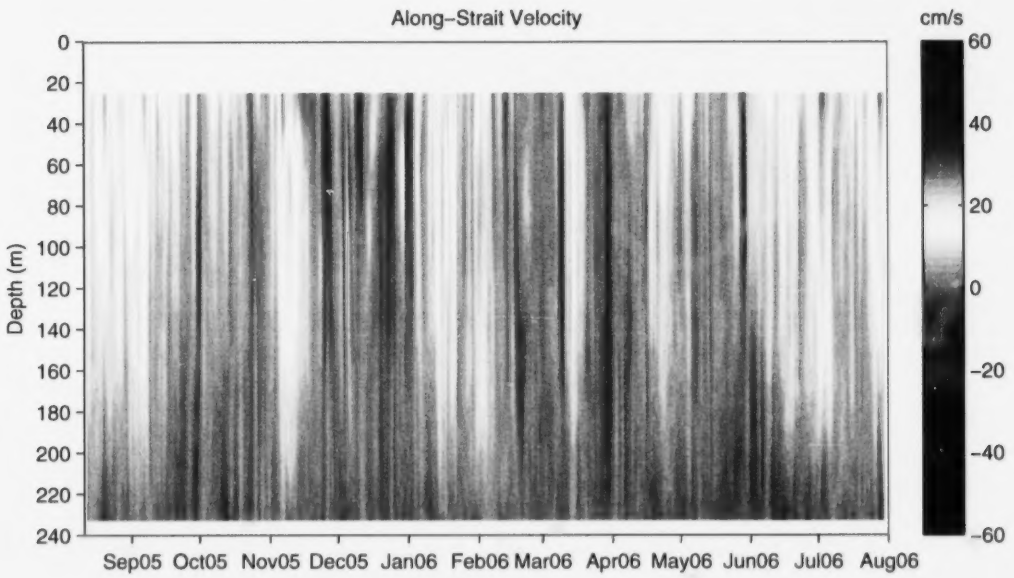


Figure 16 - Low-pass filtered currents, South Central Barrow Strait. August 2005 – July 2006



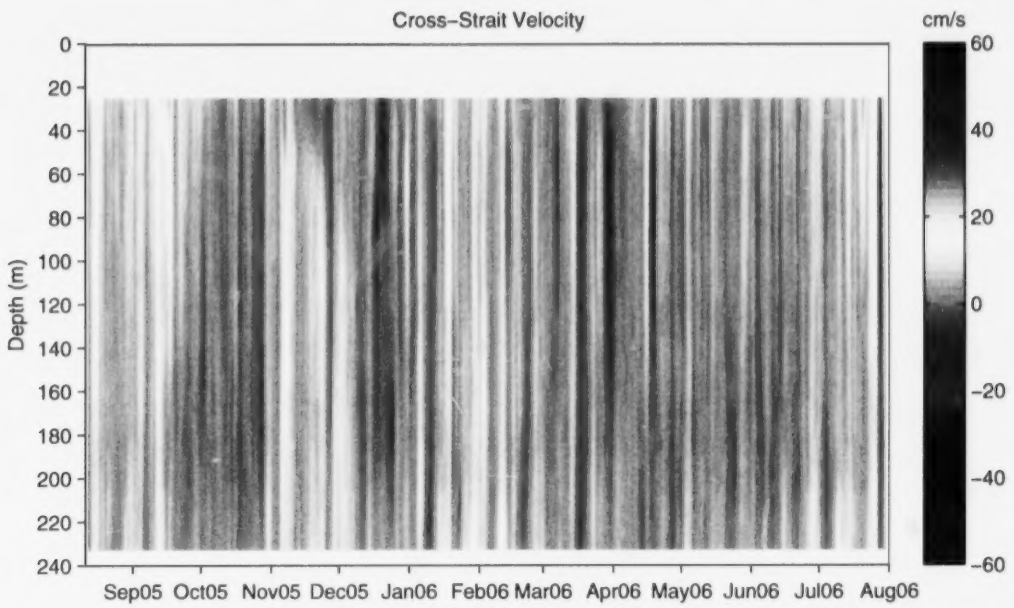


Figure 17 - Low-pass filtered currents, Central Barrow Strait. August 2005 - July 2006

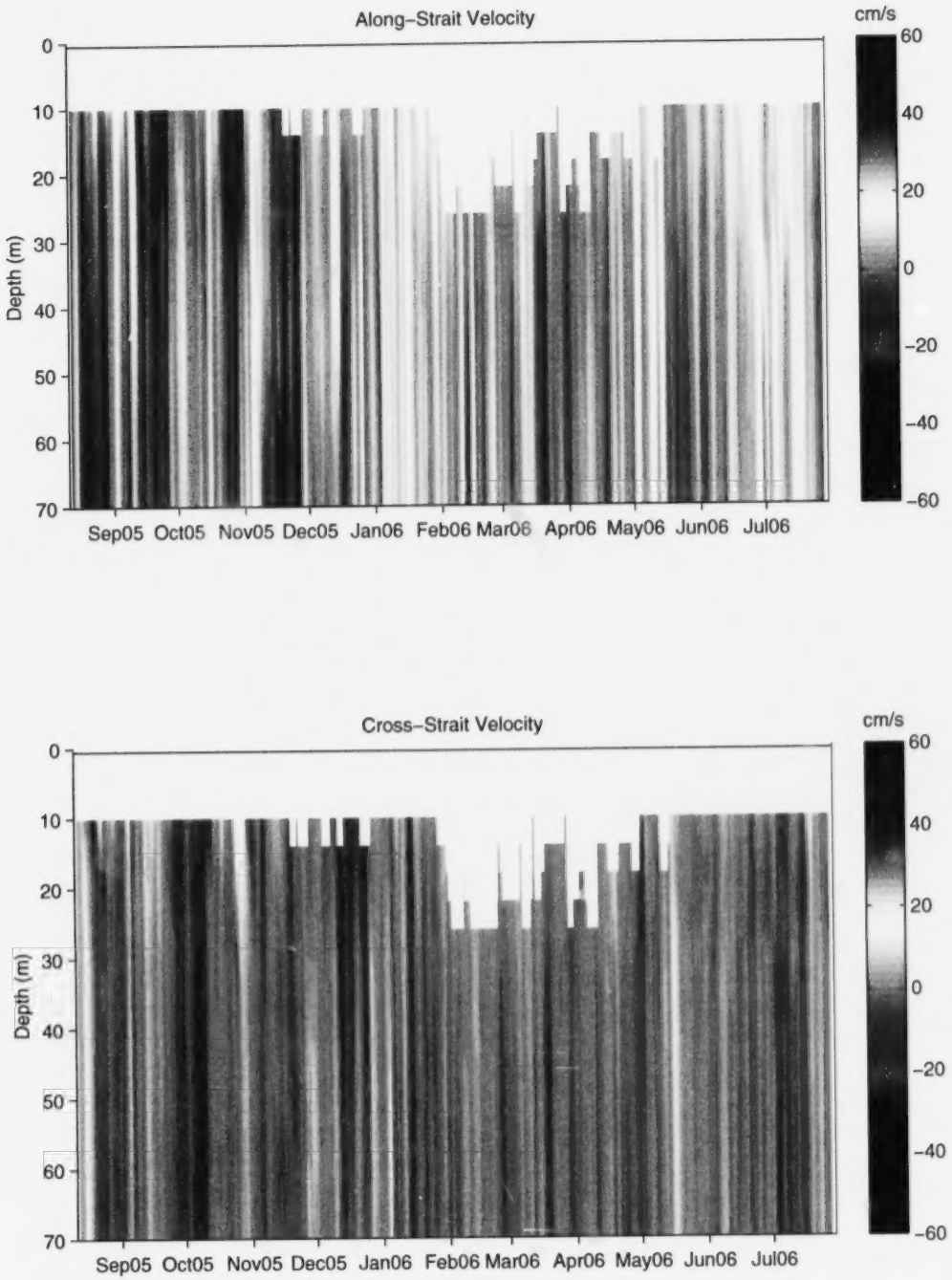
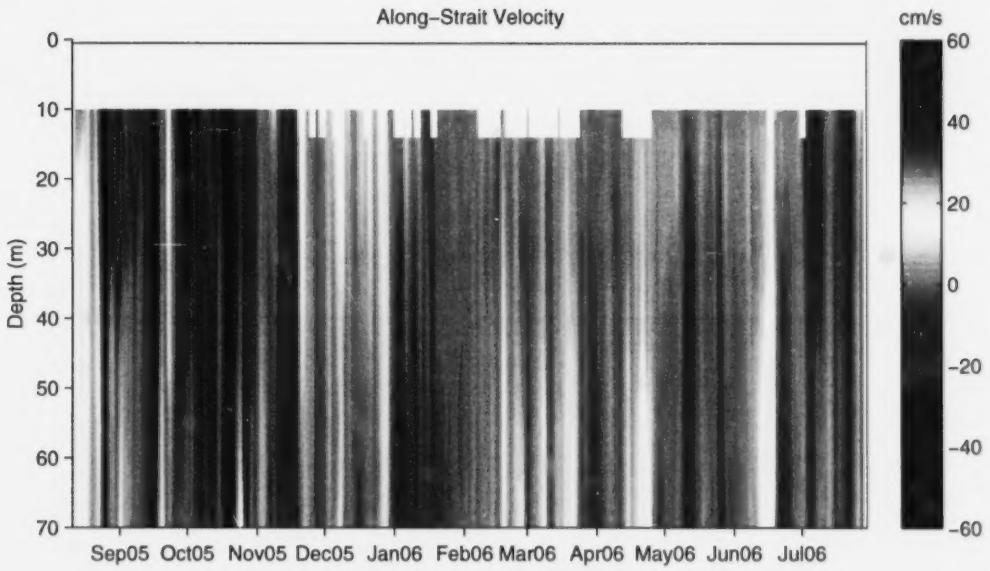


Figure 18 - Low-pass filtered currents, North Side Barrow Strait. August 2005 – July 2006



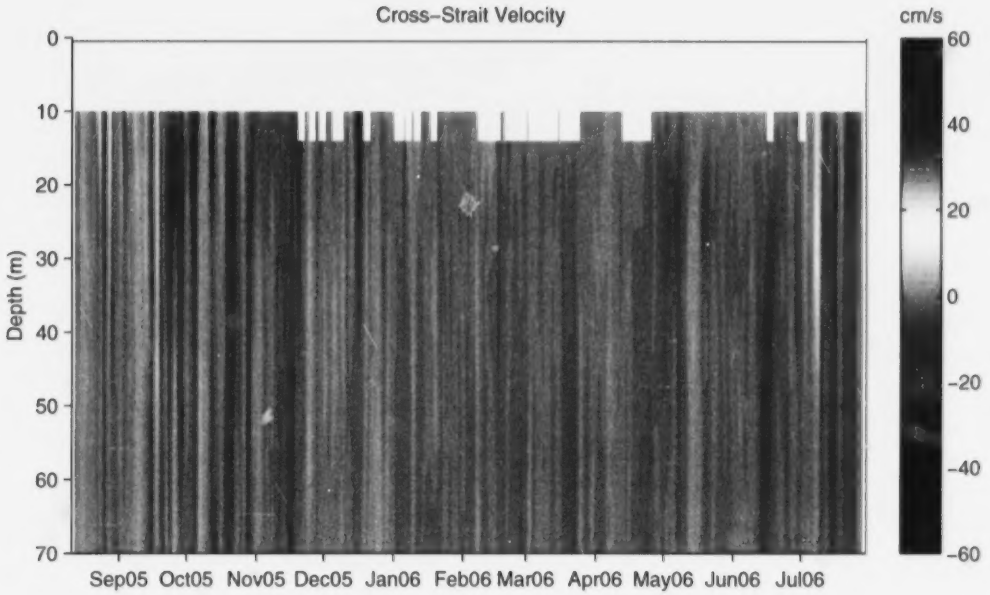


Figure 19 – Daily Icycler Measurements:
South Side Barrow Strait, August 10, 2005 – August 19, 2005

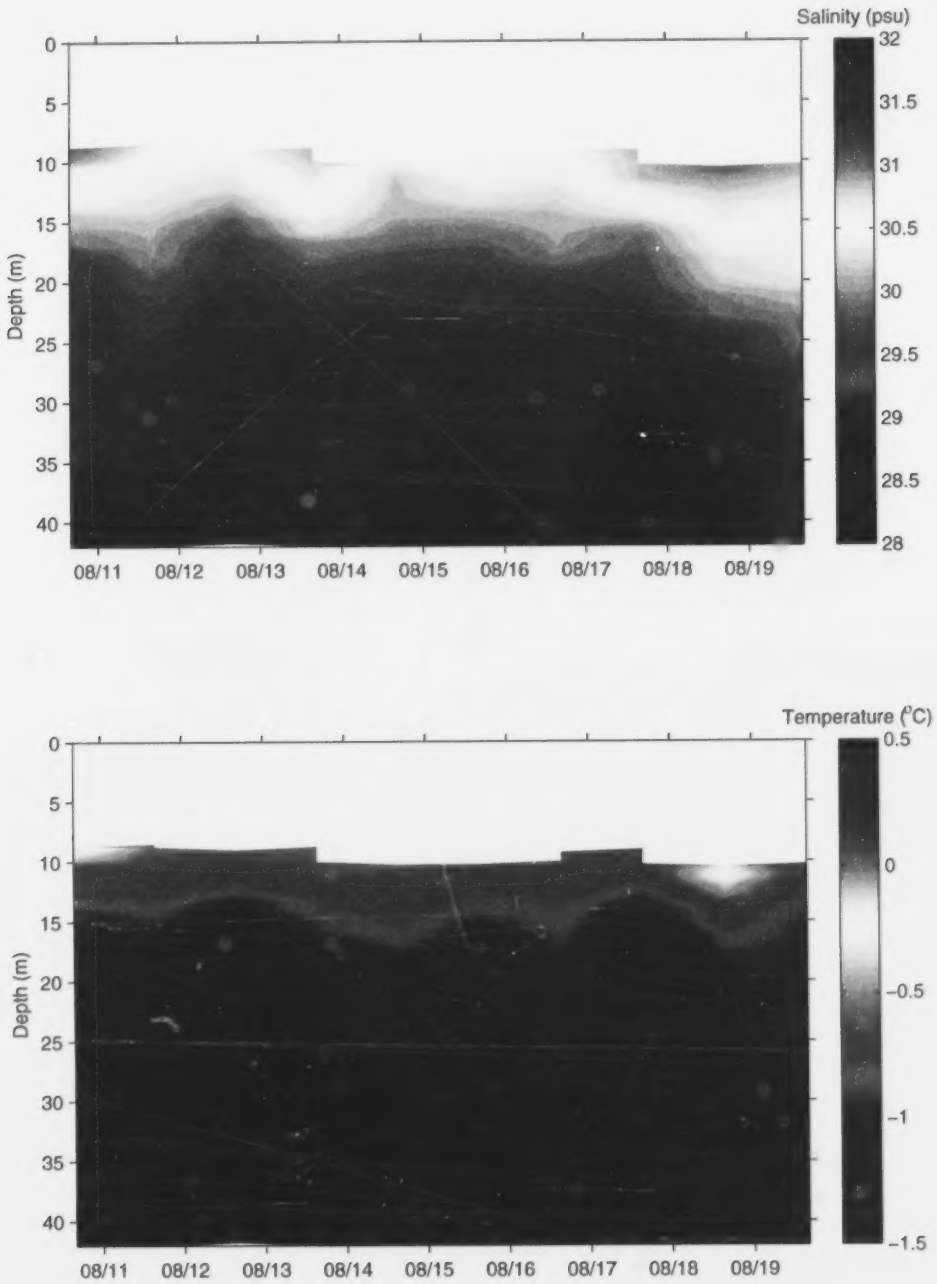
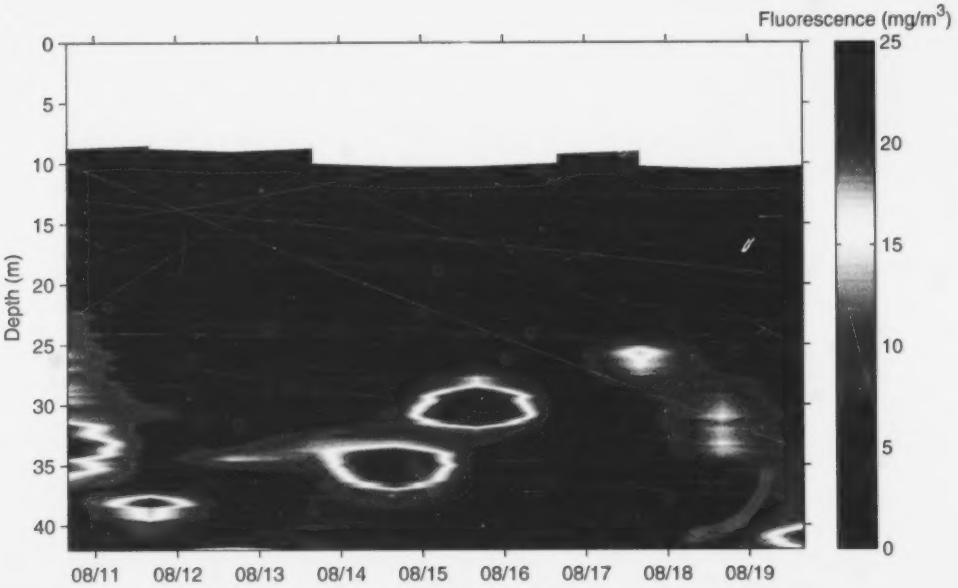


Figure 19 (continued) – Daily Icycler Measurements:
South Side Barrow Strait, August 10, 2005 – August 19, 2005



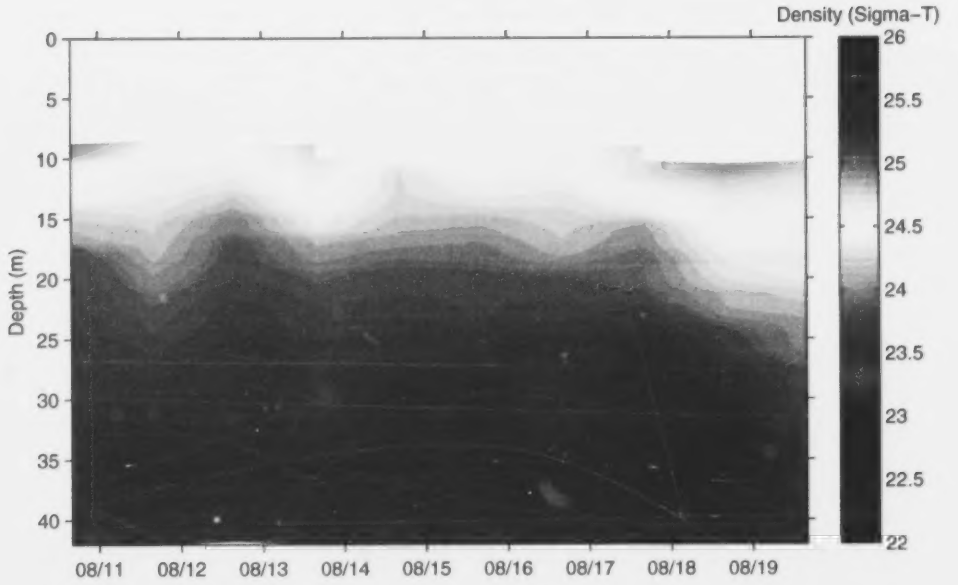


Figure 20 - Low-pass filtered T,S (38 m.) and current data (38 m.). South Side Barrow Strait: August 2005 - July 2006.

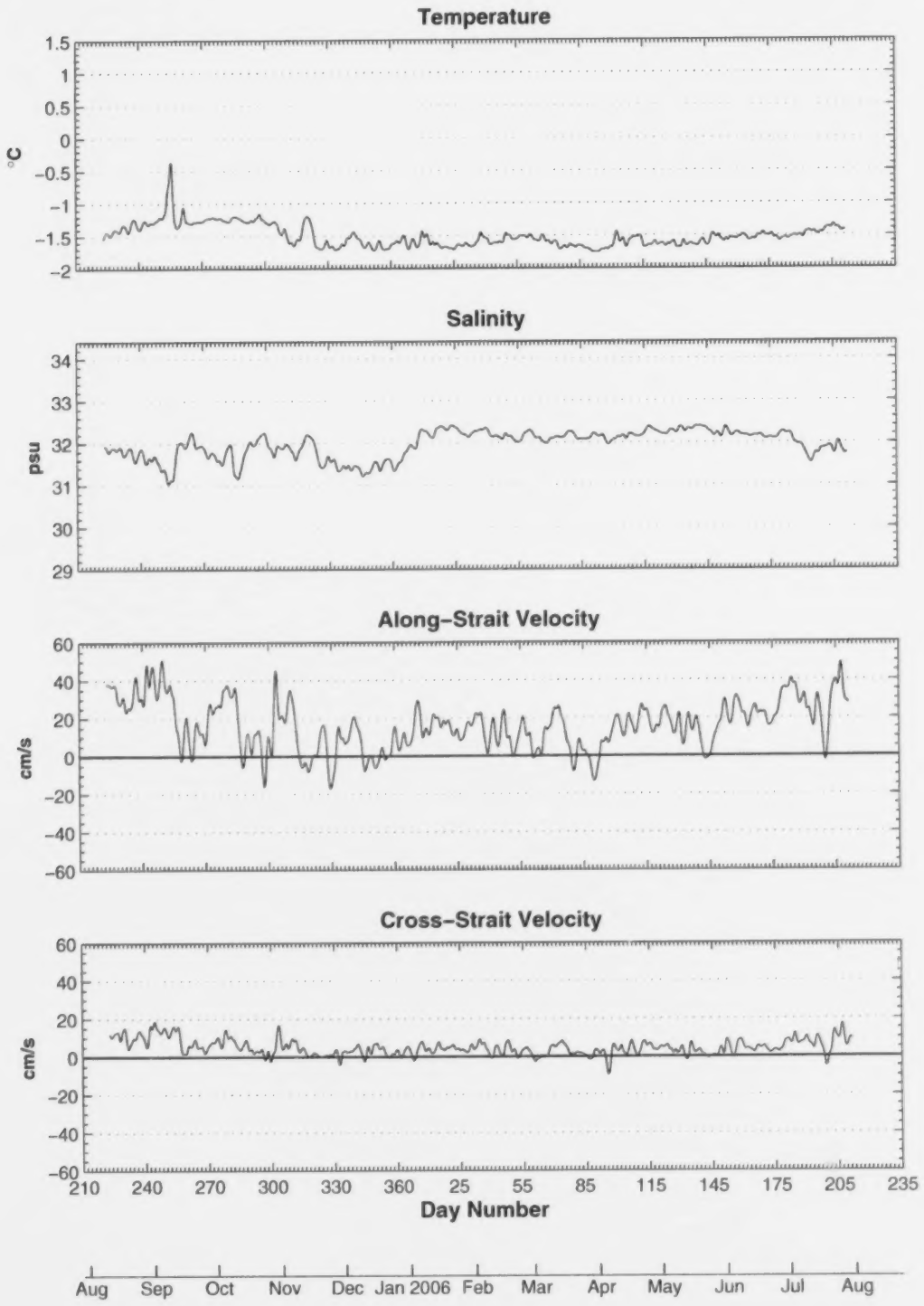


Figure 21 - Low-pass filtered T,S (78 m.) and current data (78 m.). South Side Barrow Strait: August 2005 – July 2006.

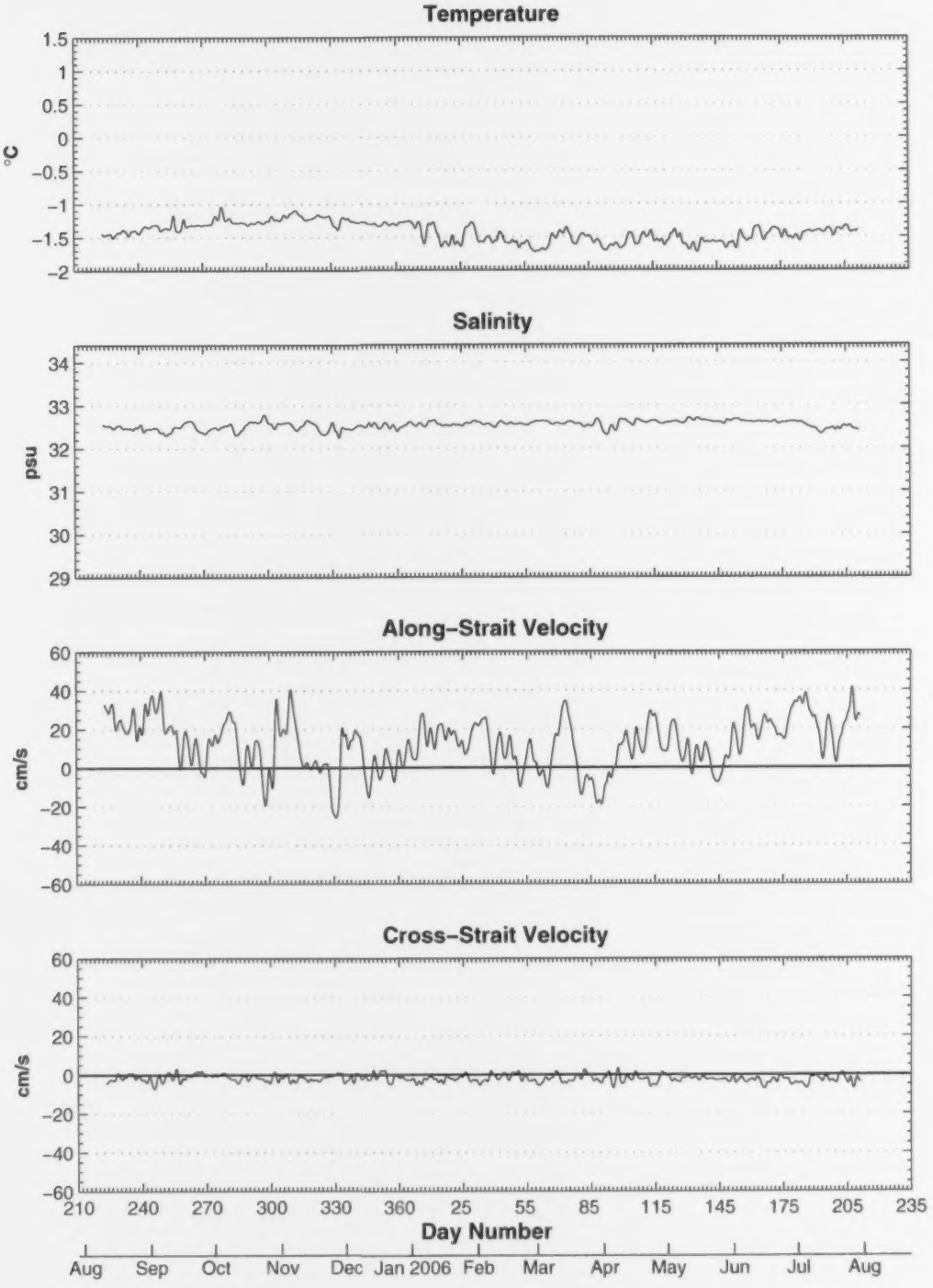


Figure 22 - Low-pass filtered T,S (146 m.) and current data (138 m.). South Side Barrow Strait: August 2005 – July 2006.

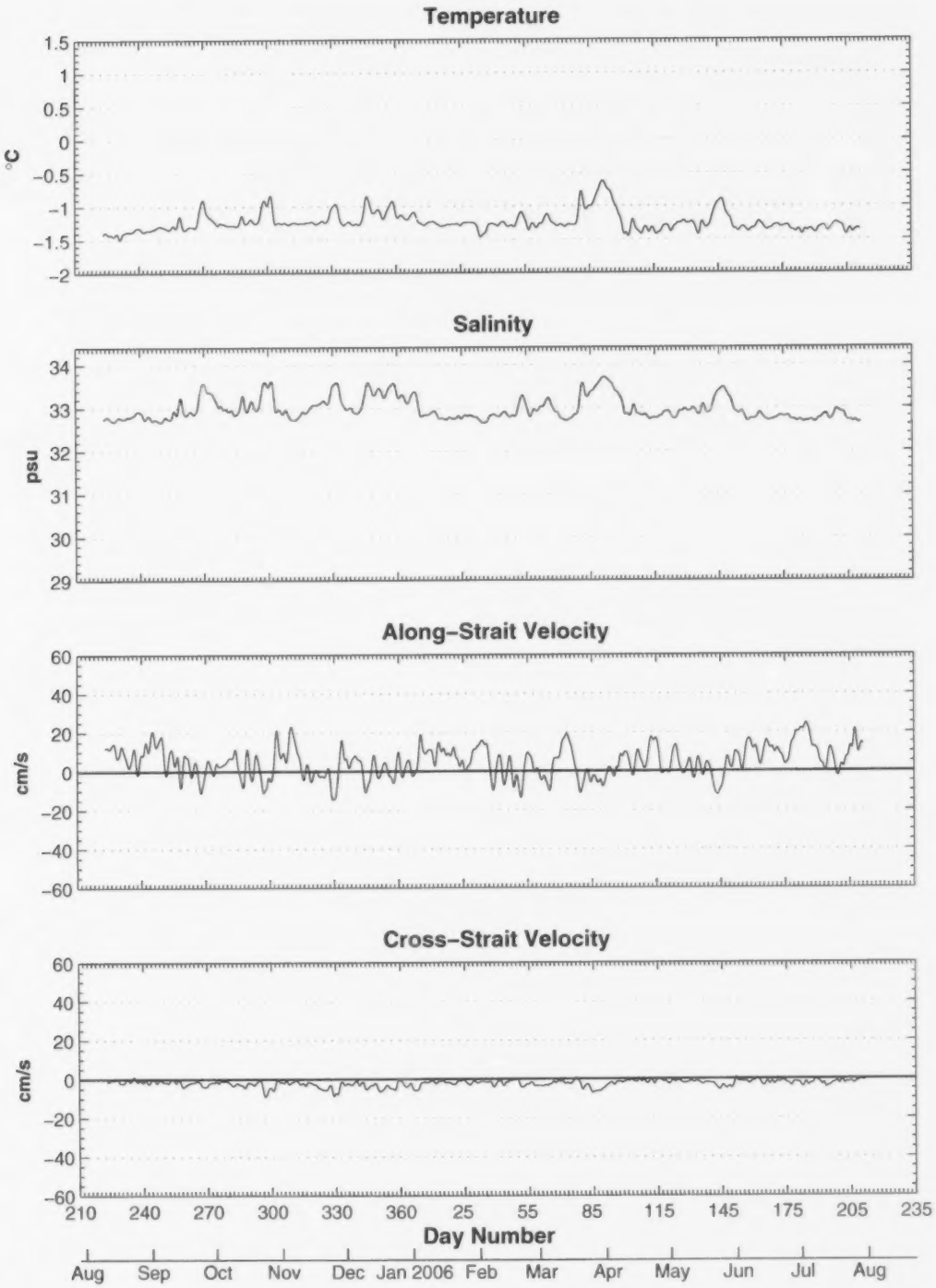


Figure 23 - Low-pass filtered T,S (39 m.) and current data (41 m.). South Central Barrow Strait: August 2005 – July 2006.

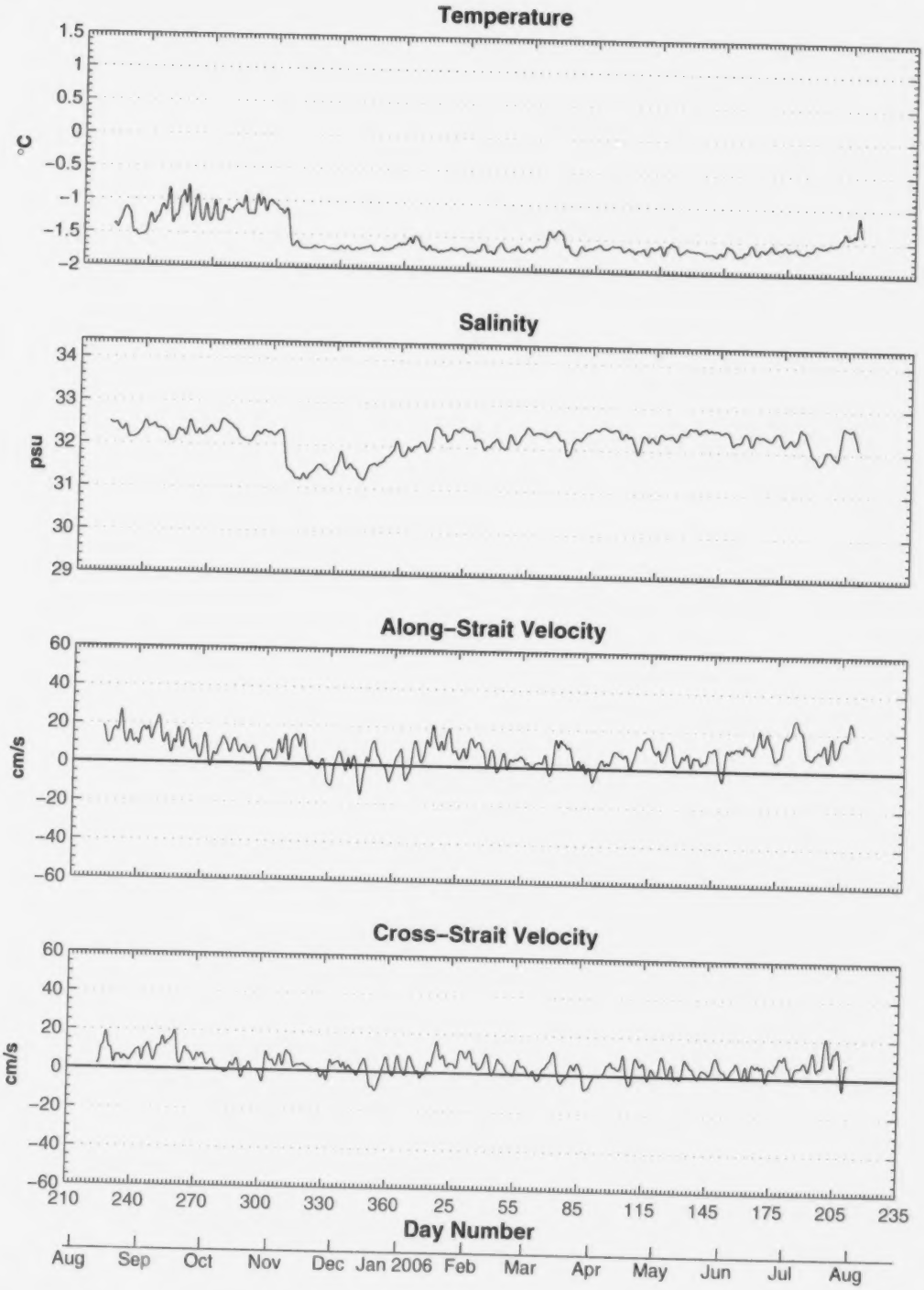


Figure 24 - Low-pass filtered T,S (81 m.) and current data (81 m.). South Central Barrow Strait: August 2005 - July 2006.

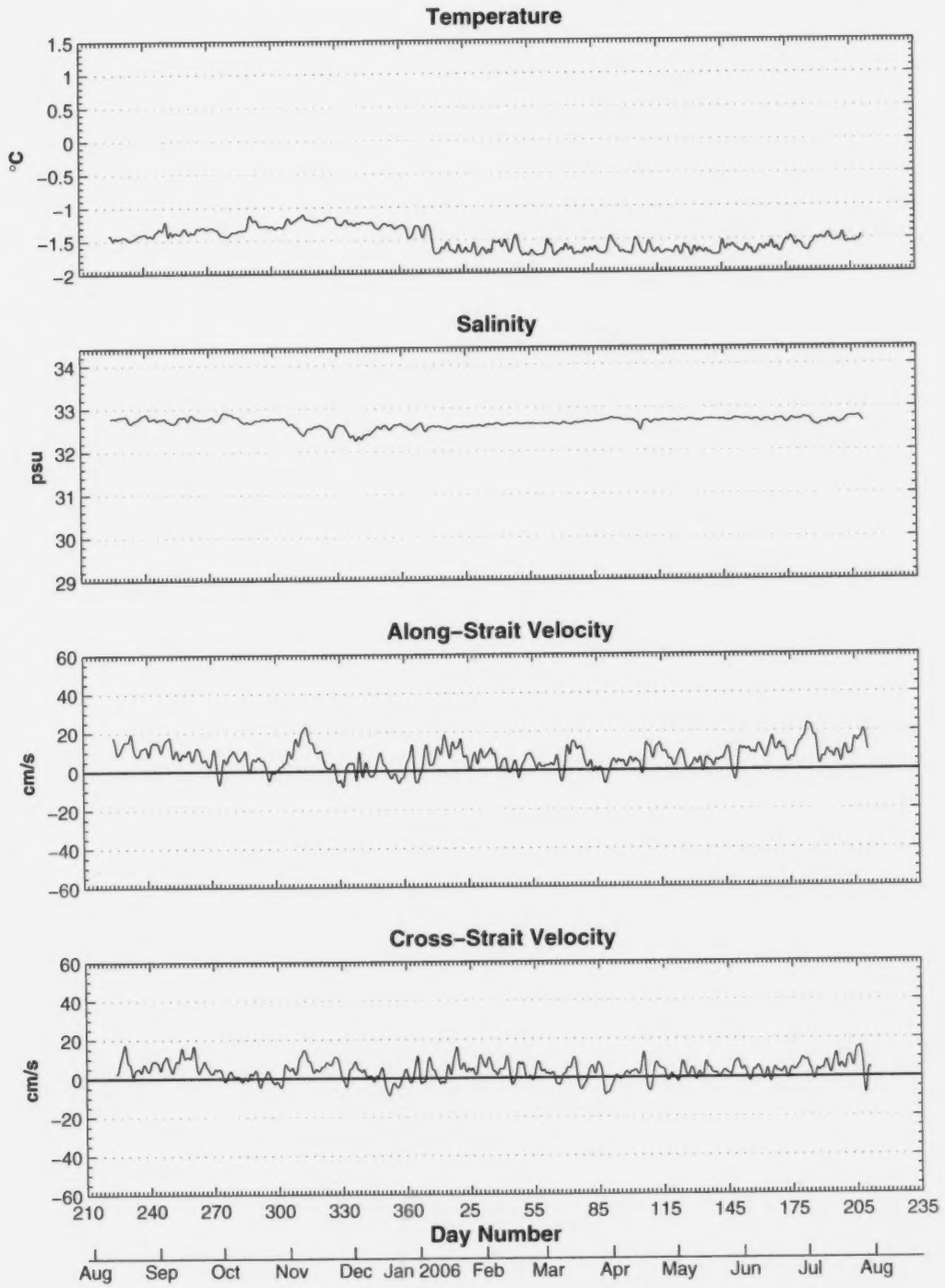


Figure 25 - Low-pass filtered T,S (160 m.) and current data (161 m.). South Central Barrow Strait: August 2005 - July 2006.

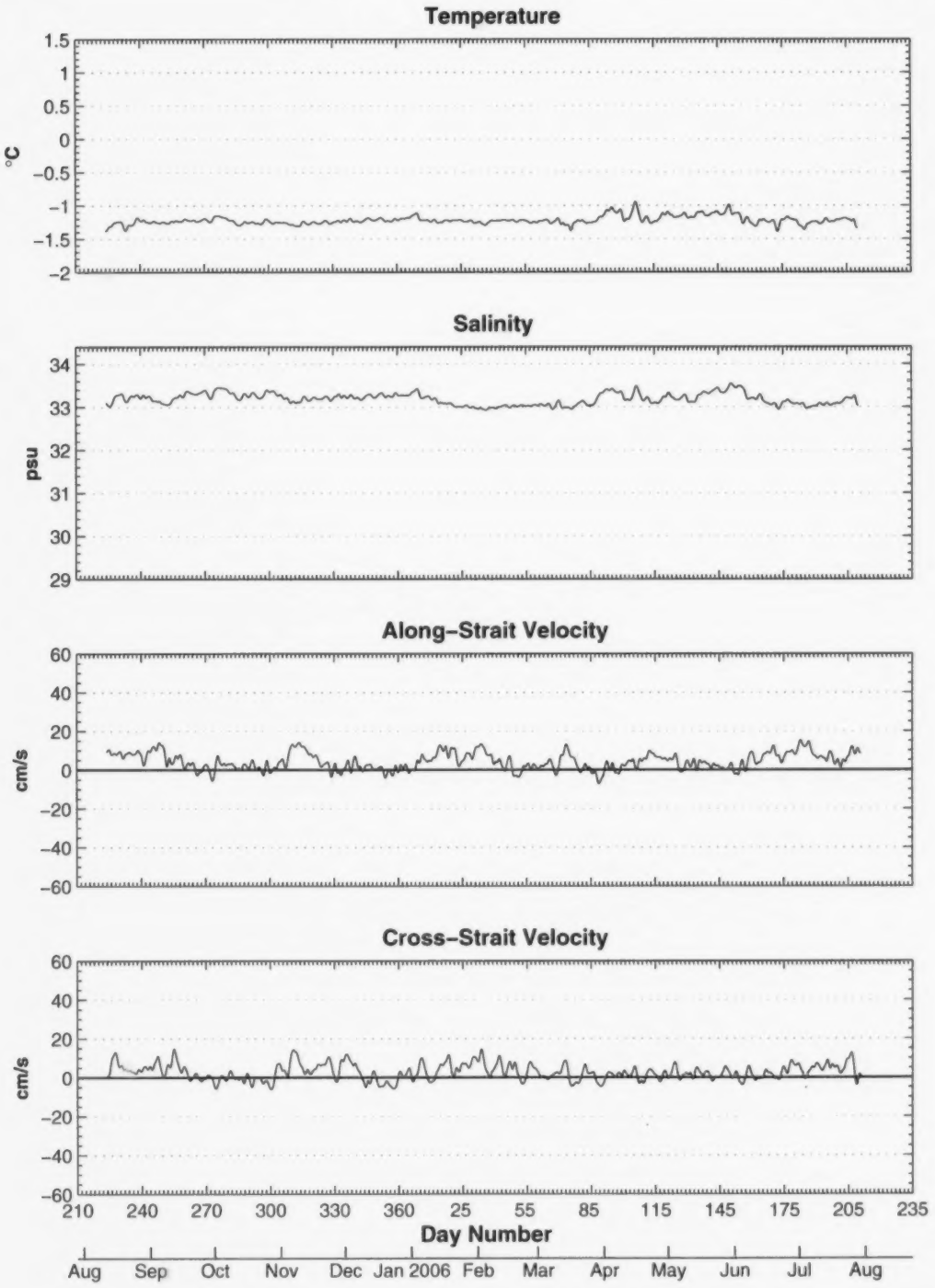


Figure 26 - Low-pass filtered T,S (264 m.) and current data (233 m). South Central Barrow Strait: August 2005 – July 2006.

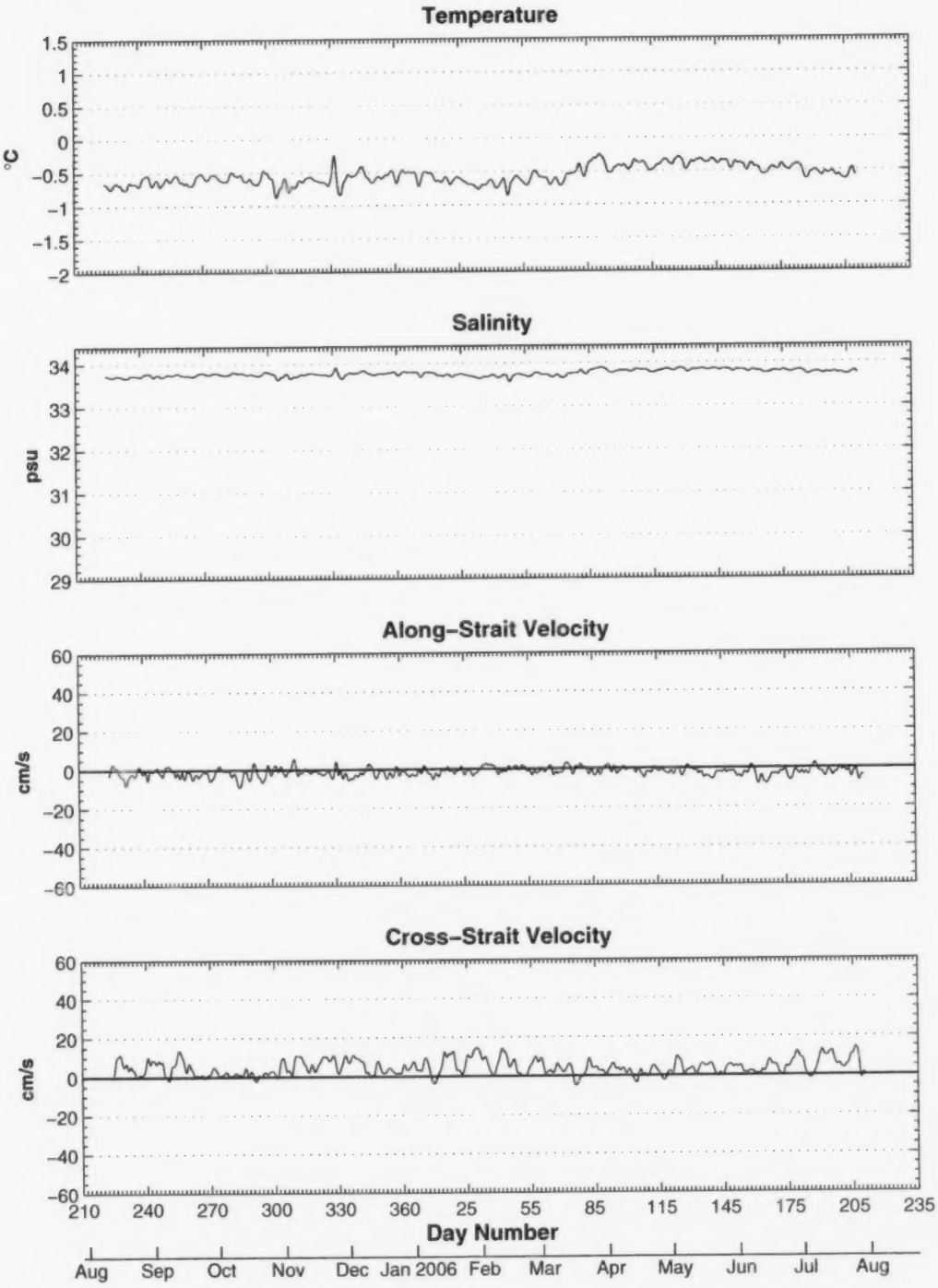


Figure 27 - Low-pass filtered T,S (38 m.) and current data (38 m.). Central Barrow Strait: August 2005 – July 2006.

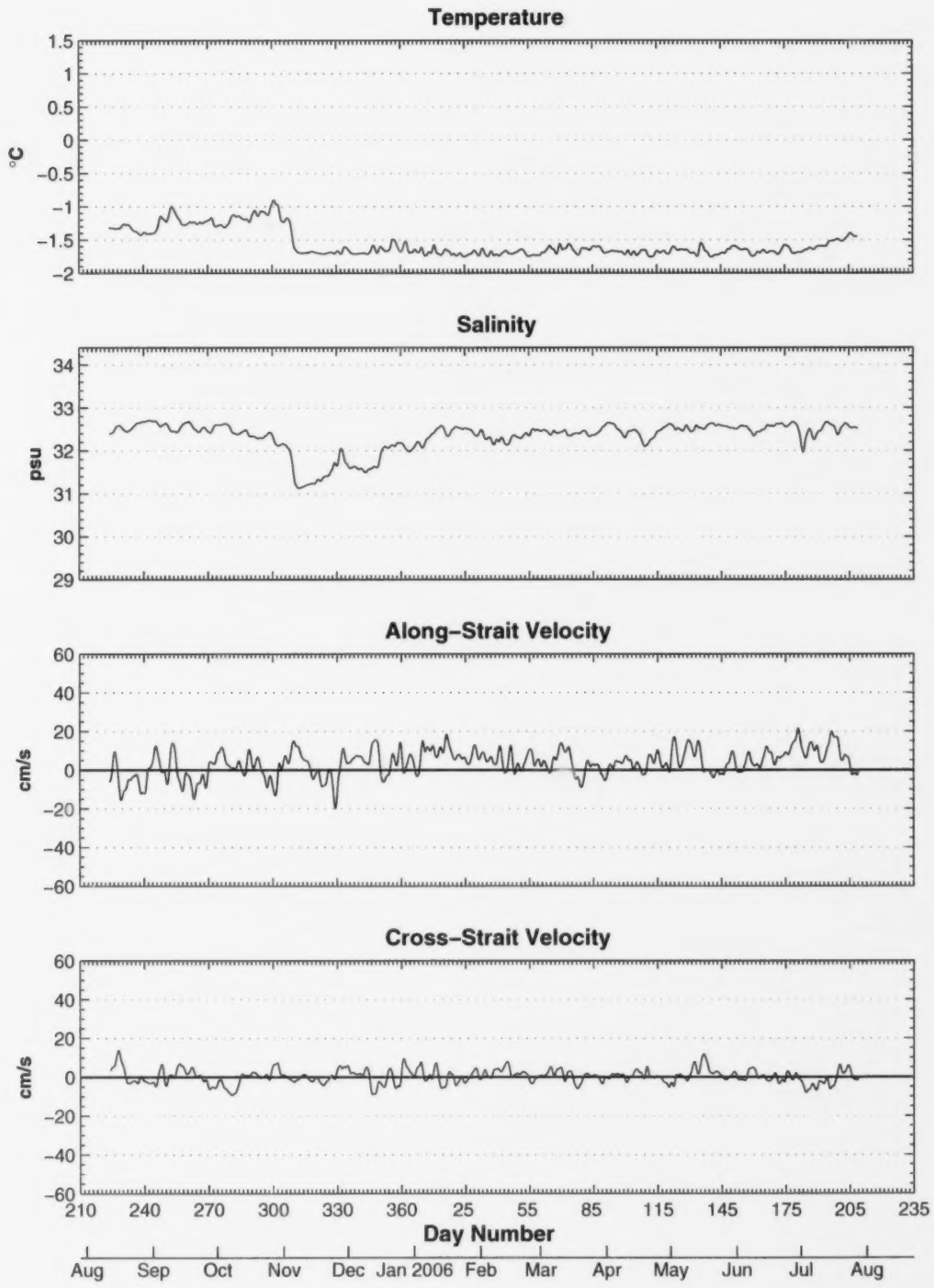


Figure 28 - Low-pass filtered T,S (78 m.) and current data (70 m.). Central Barrow Strait: August 2005 – July 2006.

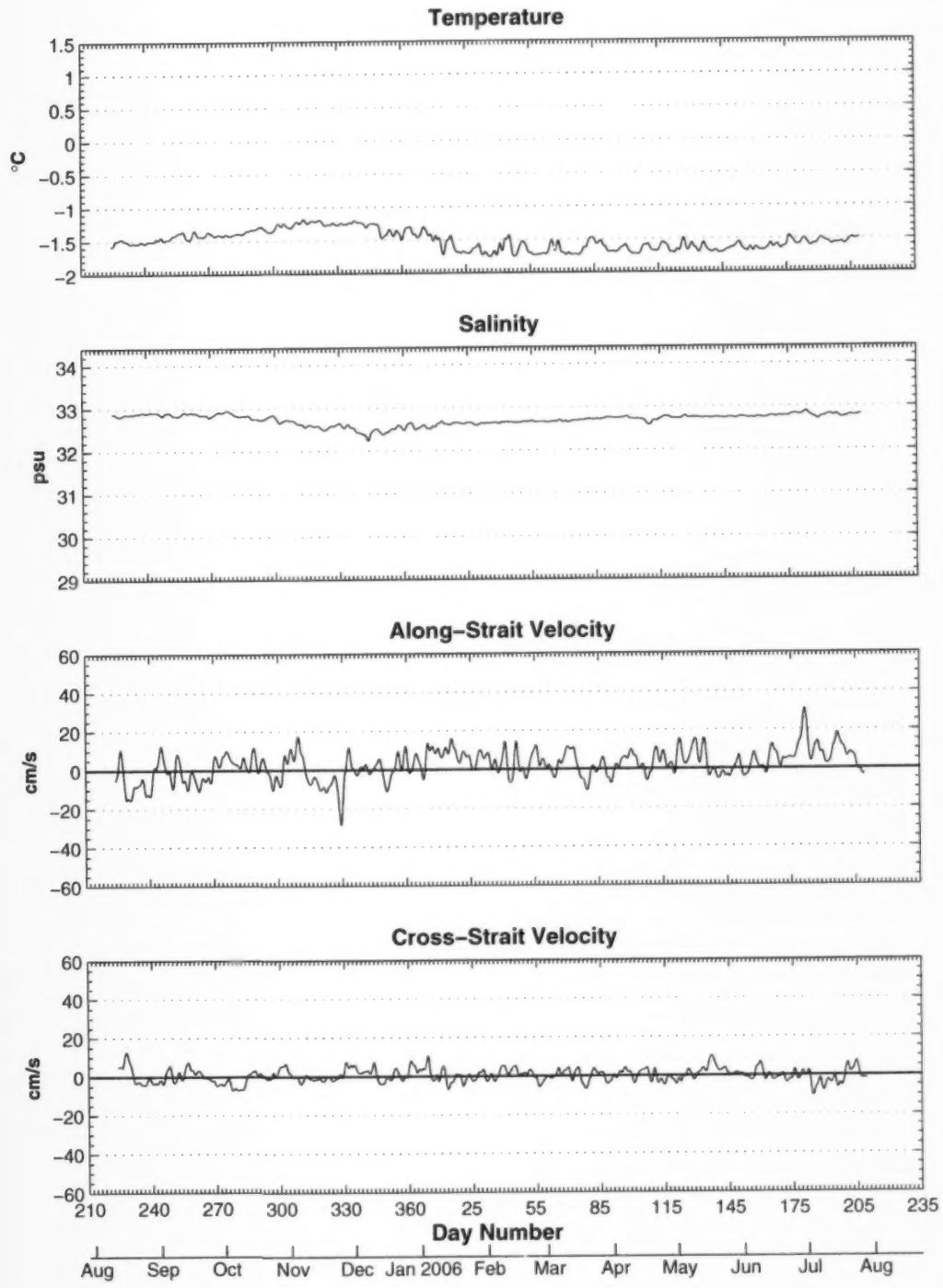


Figure 29 - Low-pass filtered T,S (157 m.).
Central Barrow Strait: August 2005 – July 2006.

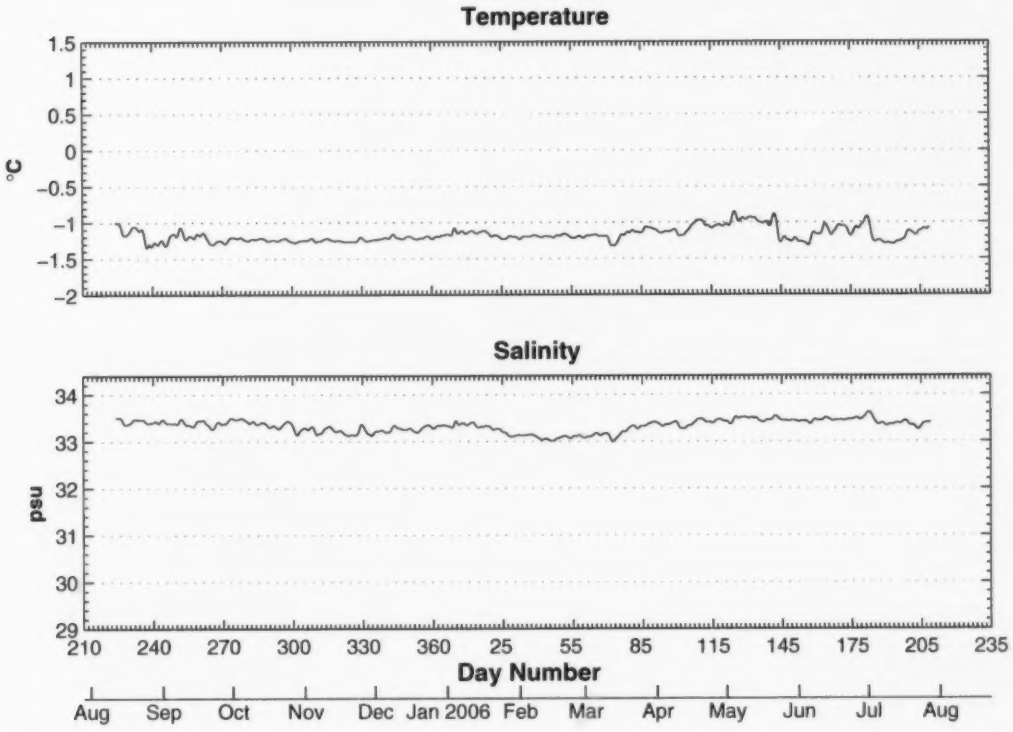


Figure 30 - Low-pass filtered T,S (39 m.) and current data (38 m.). North Side Barrow Strait: August 2005 - July 2006.

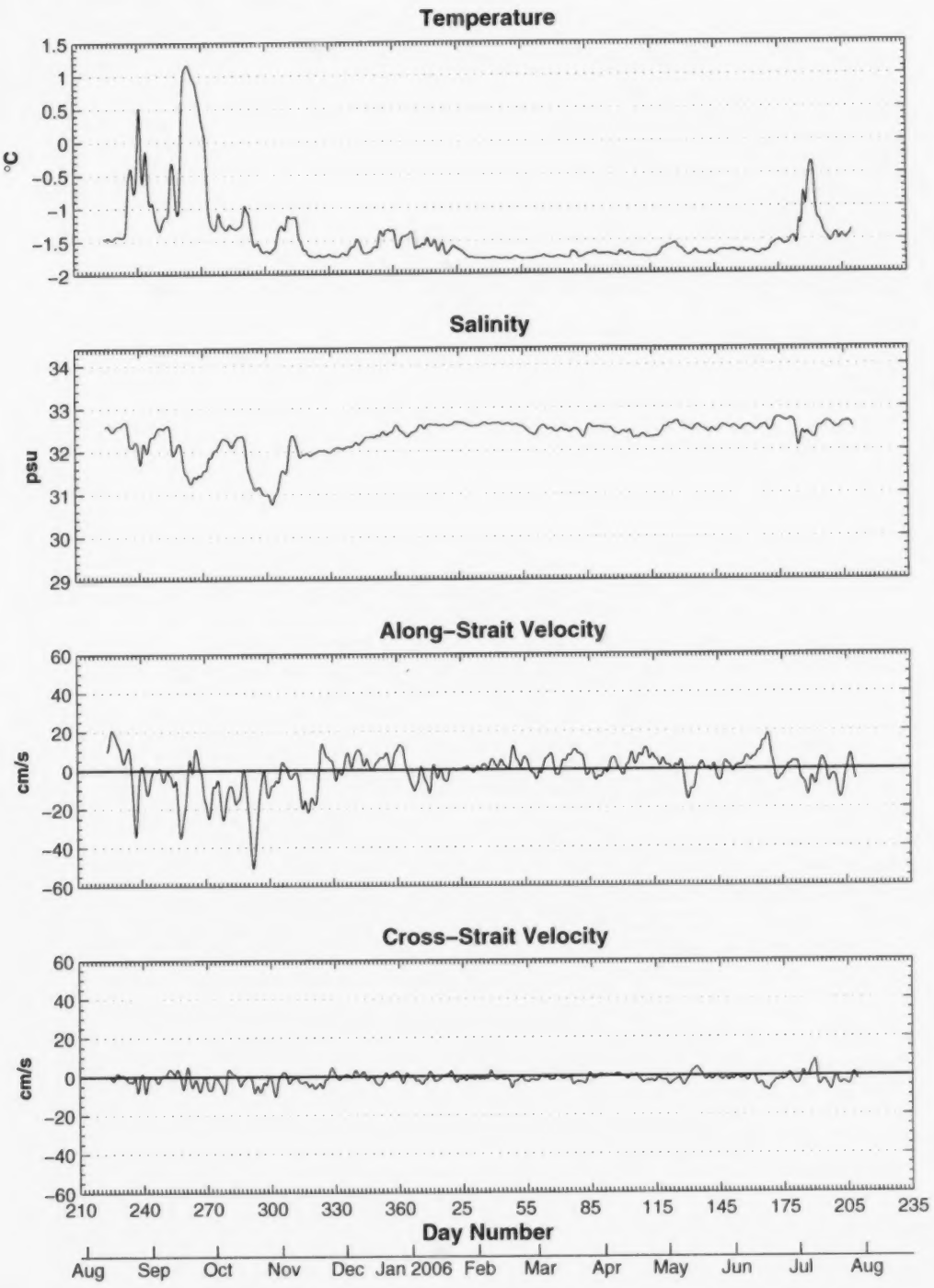


Figure 31 - Low-pass filtered T,S (78 m.) and current data (70 m.) North Side Barrow Strait: August 2005 – July 2006.

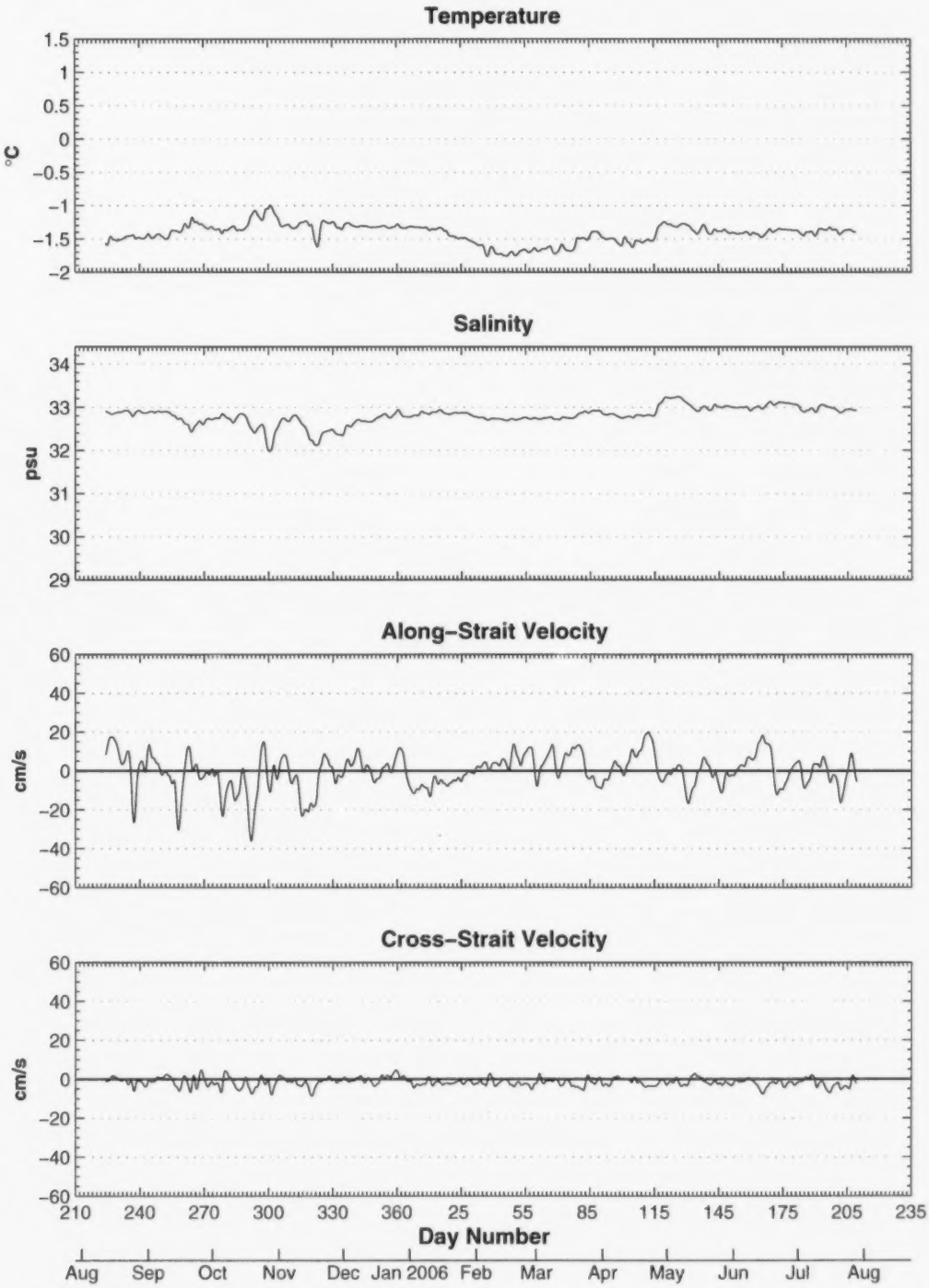


Figure 32 - Low-pass filtered T,S (158 m.).
North Side Barrow Strait: August 2005 – July 2006.

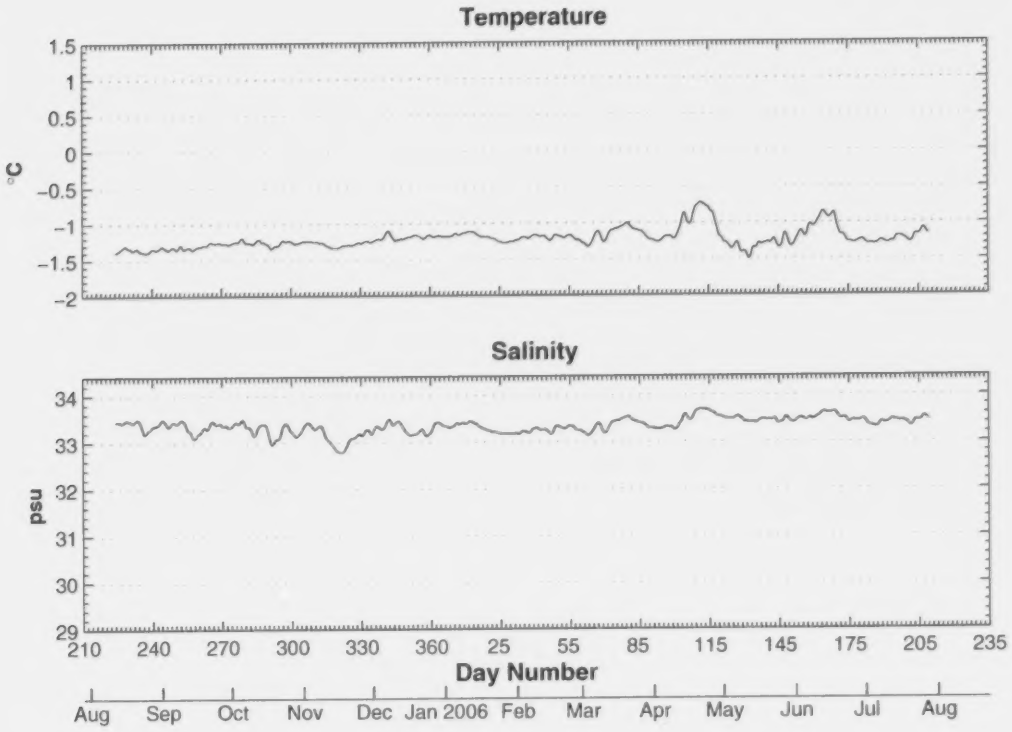
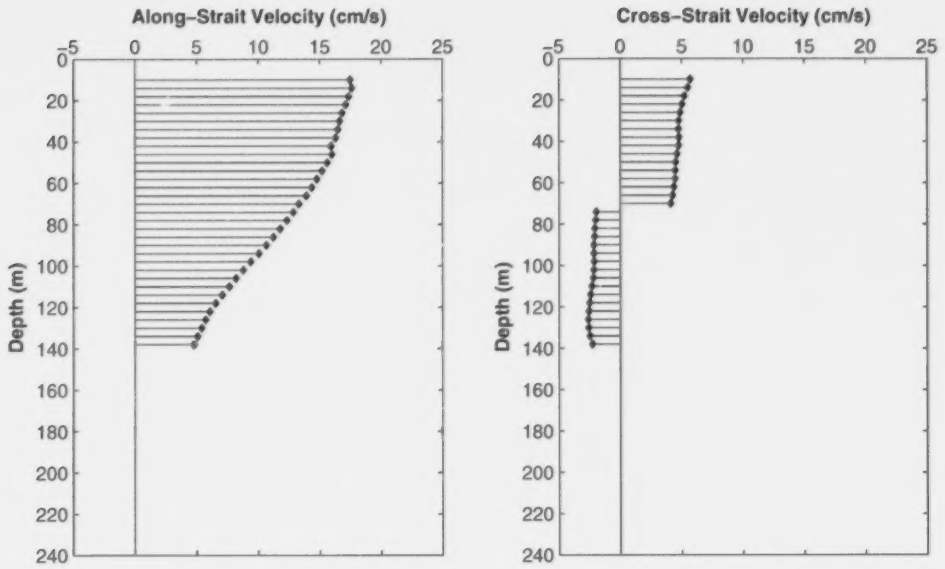


Figure 33: Mean Flows, Aug. 10, 2005 to Jul. 31, 2006.

South side of Barrow Strait



South-Central Barrow Strait

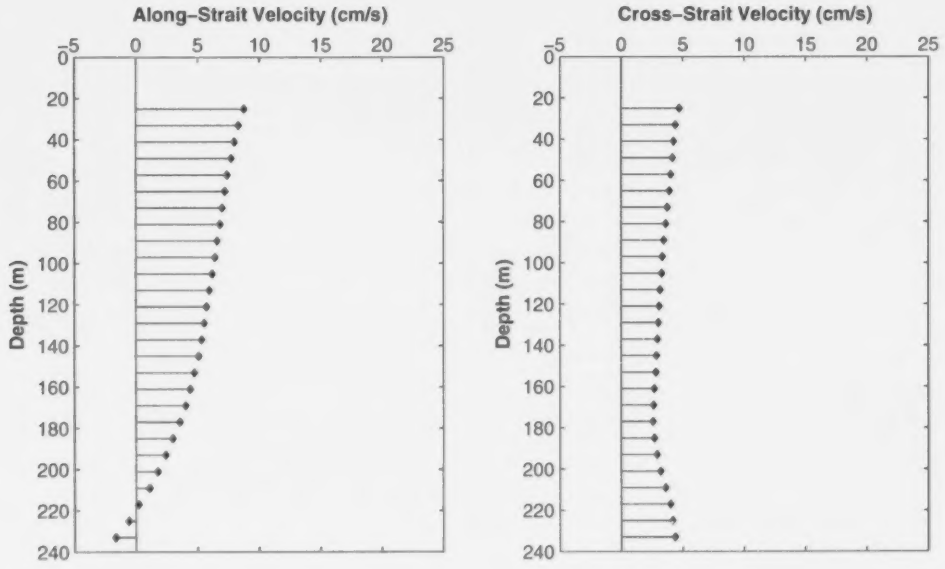
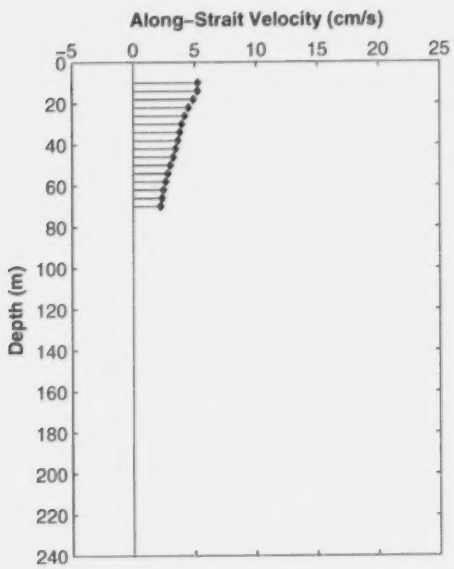
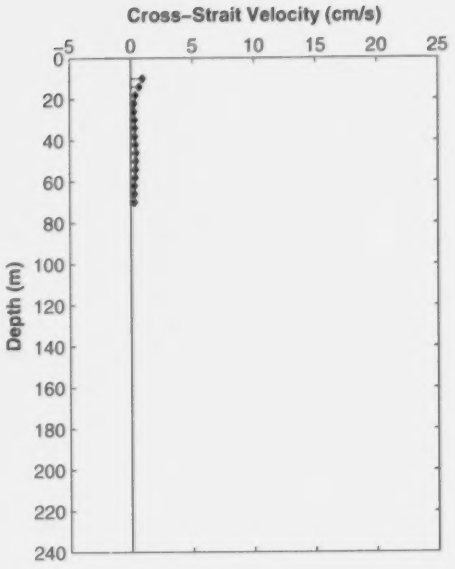


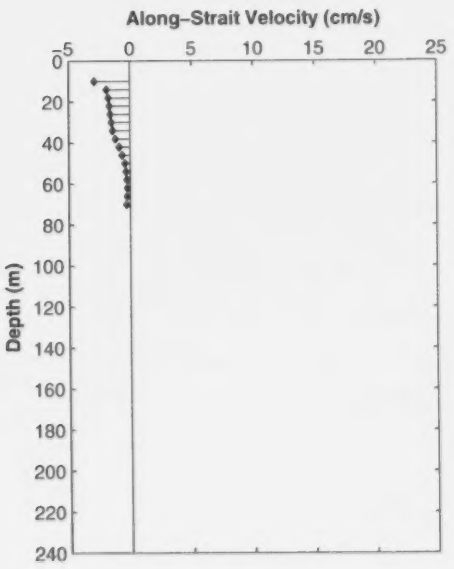
Figure 33: Mean Flows, Aug. 10, 2005 to Jul. 29, 2006. (continued)

Central Barrow Strait





North side of Barrow Strait



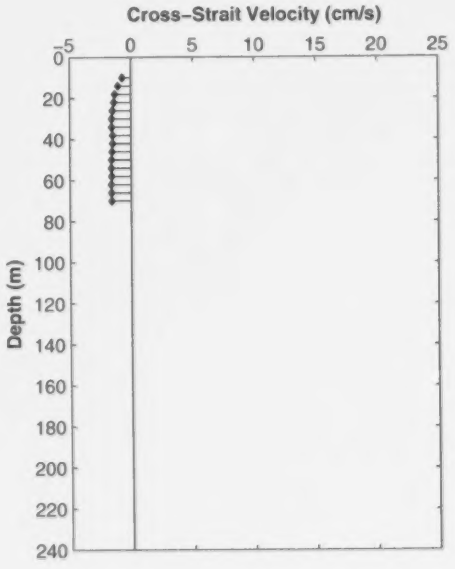


Figure 34: Mean Flows, Late Summer: Aug. 2005 to Sep. 2005.

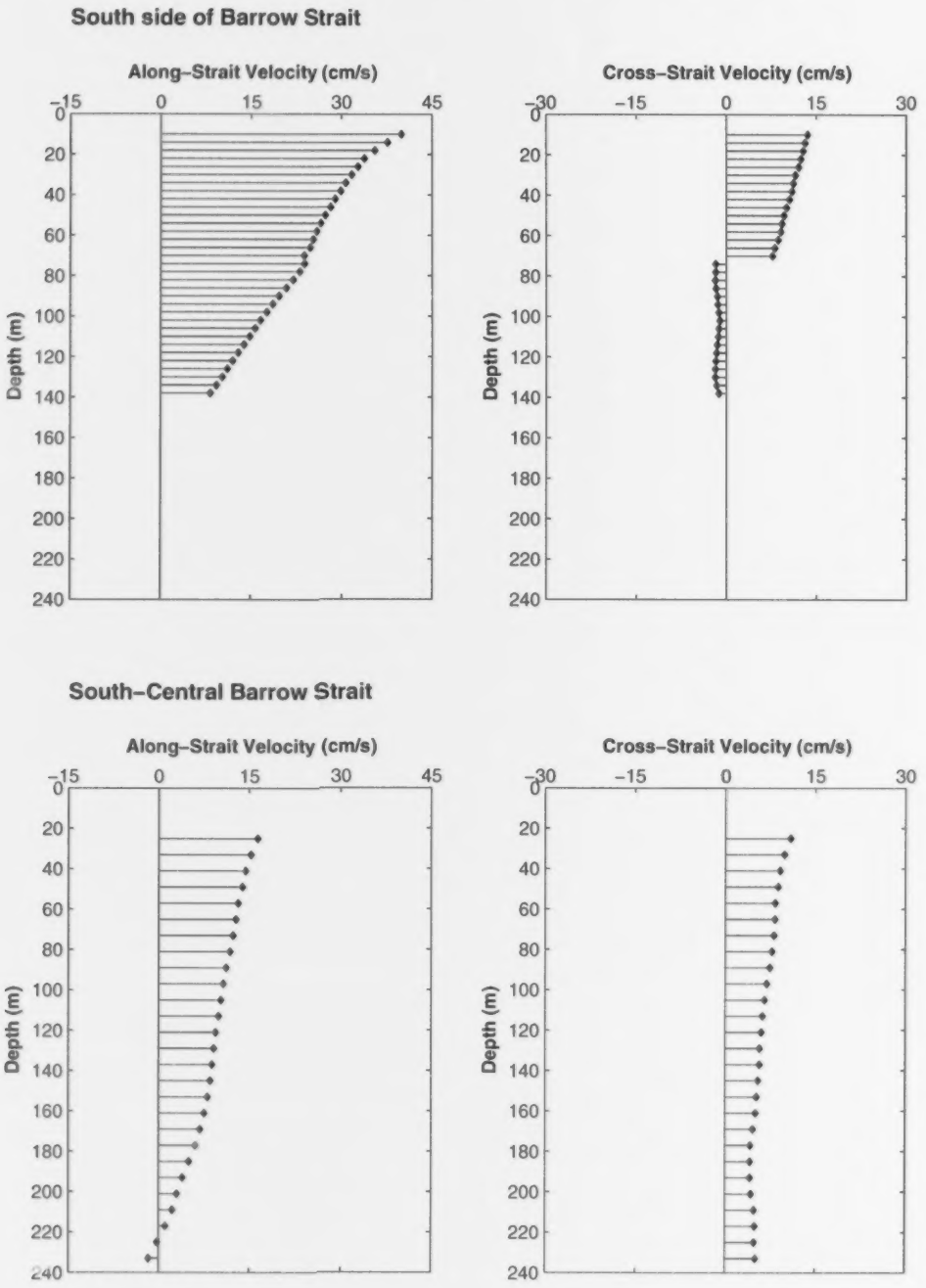
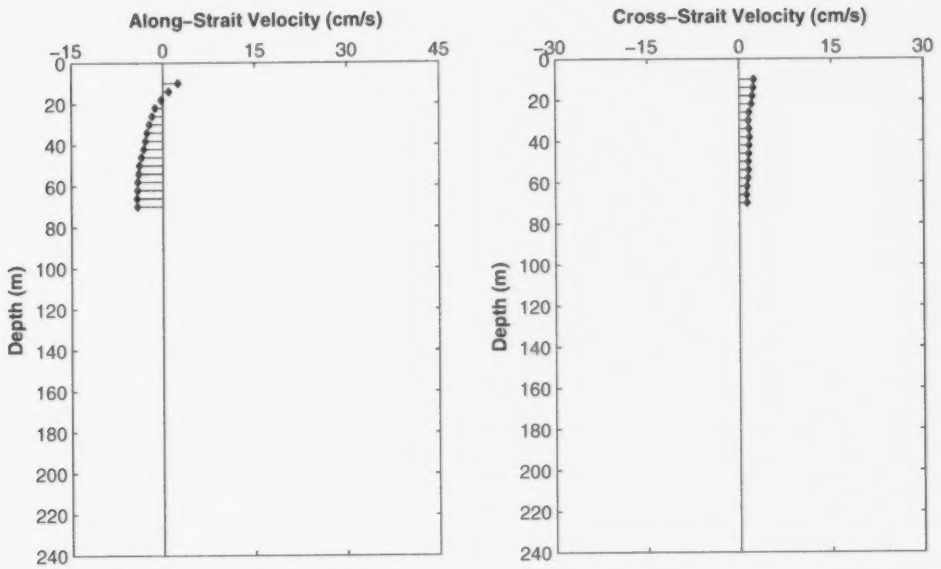


Figure 34: Mean Flows, Late Summer: Aug. 2005 to Sep. 2005 (continued)

Central Barrow Strait



North side of Barrow Strait

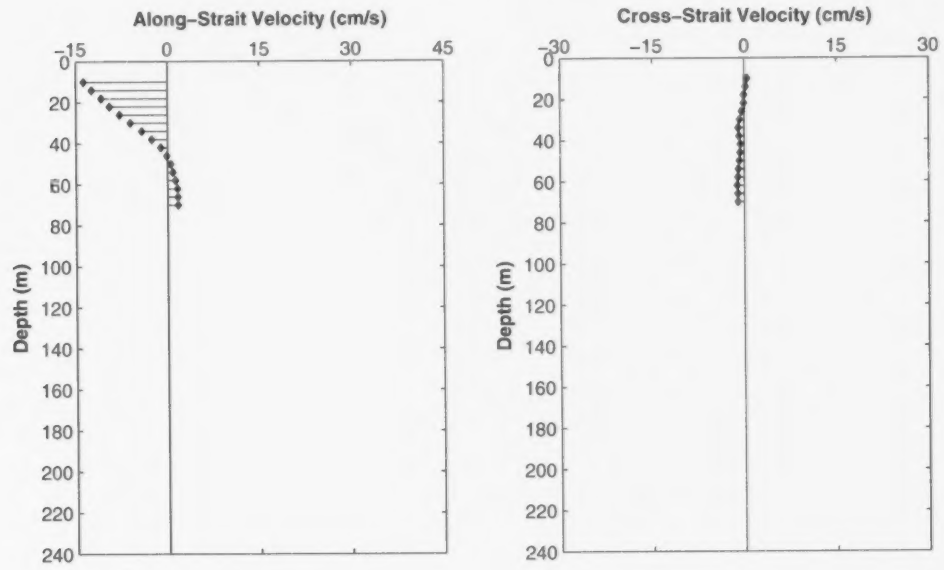
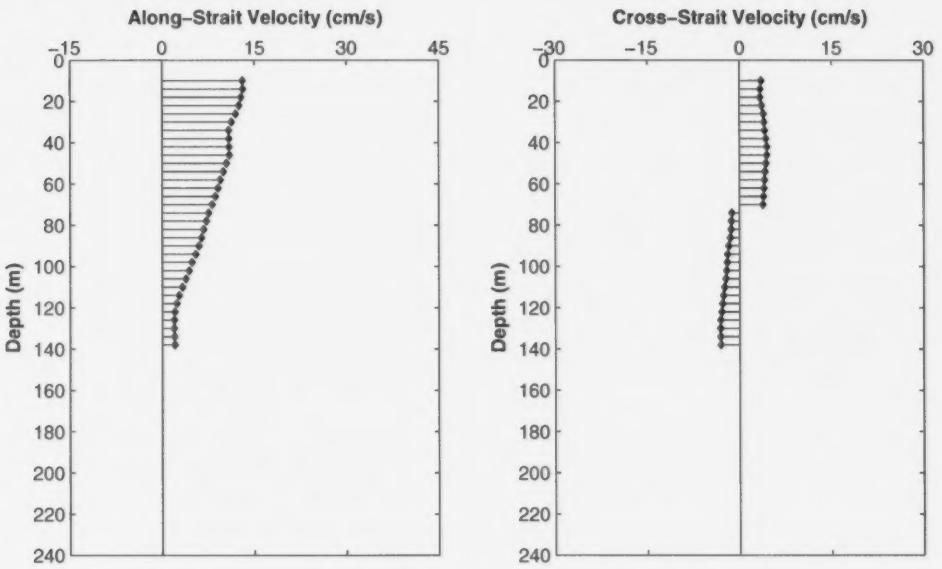


Figure 35: Mean Flows, Fall: Sep. 2005 to Dec. 2005.

South side of Barrow Strait



South–Central Barrow Strait

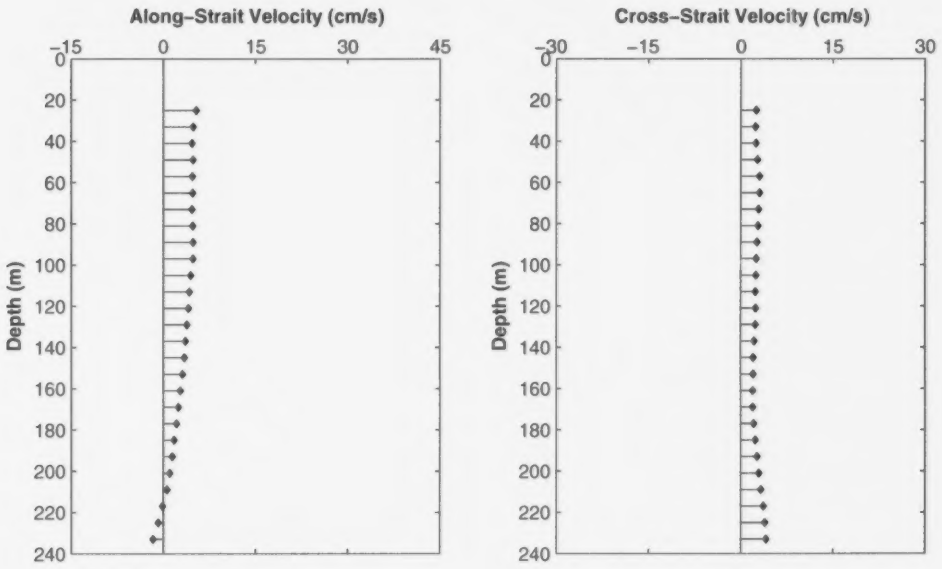


Figure 35: Mean Flows, Fall: Sep. 2005 to Dec. 2005 (continued).

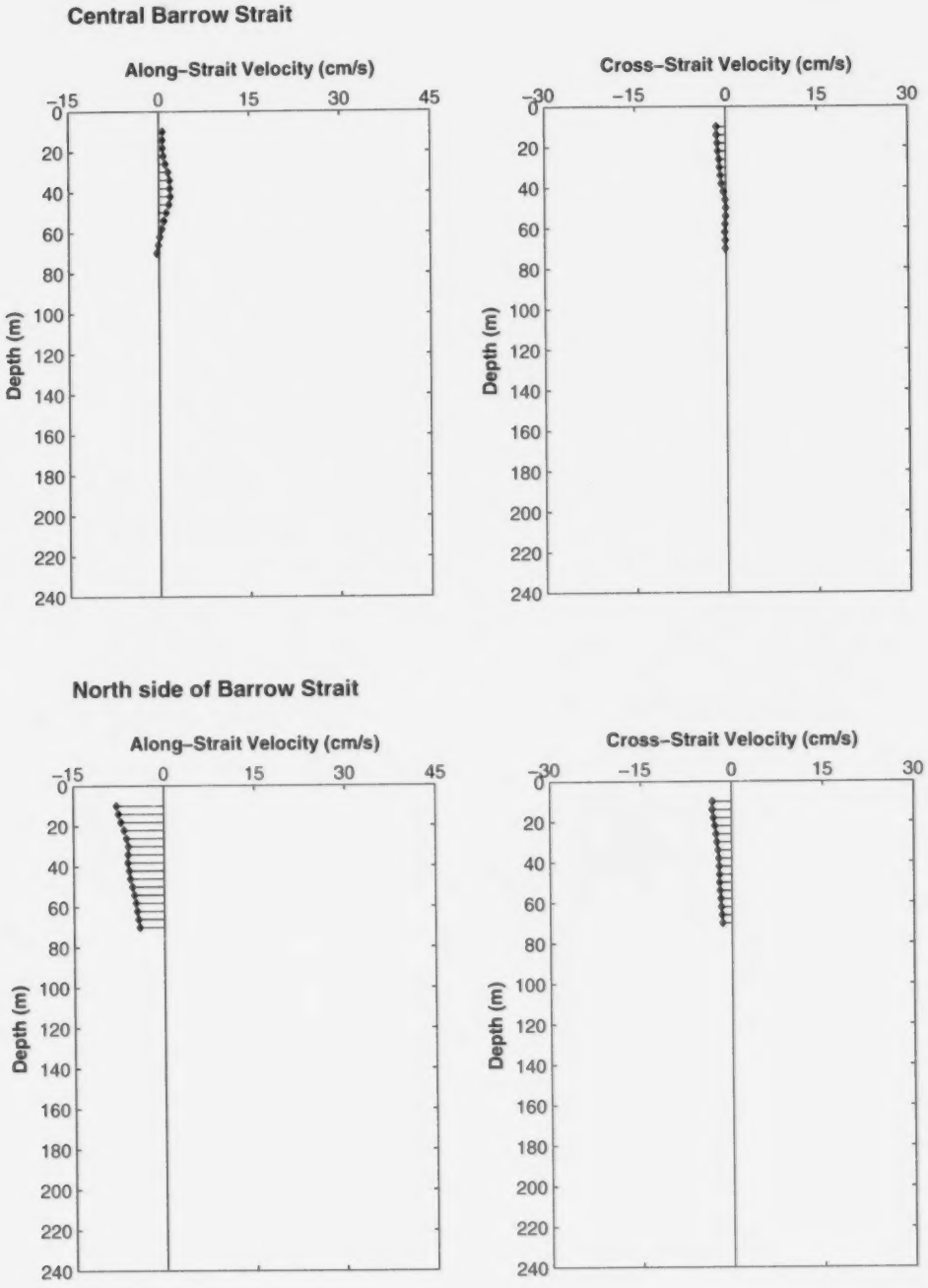
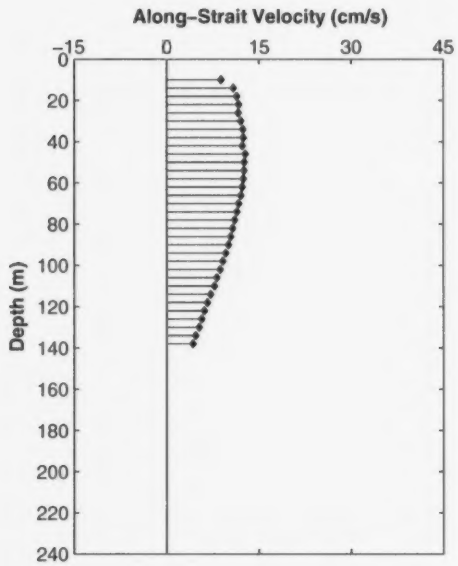
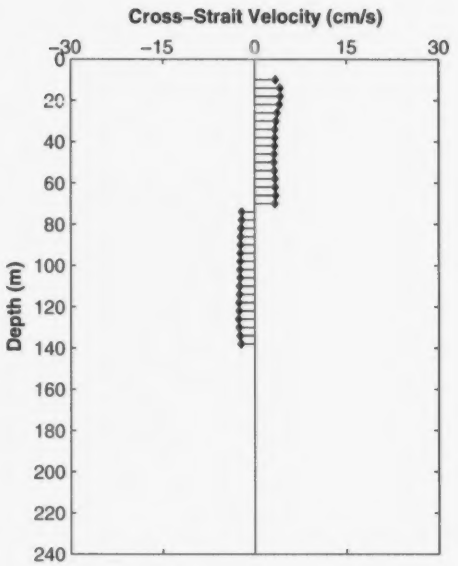


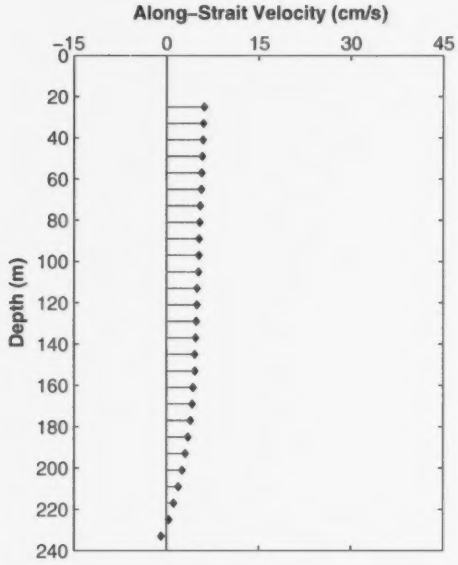
Figure 36: Mean Flows, Winter: Dec. 2005 to Mar. 2006.

South side of Barrow Strait





South–Central Barrow Strait



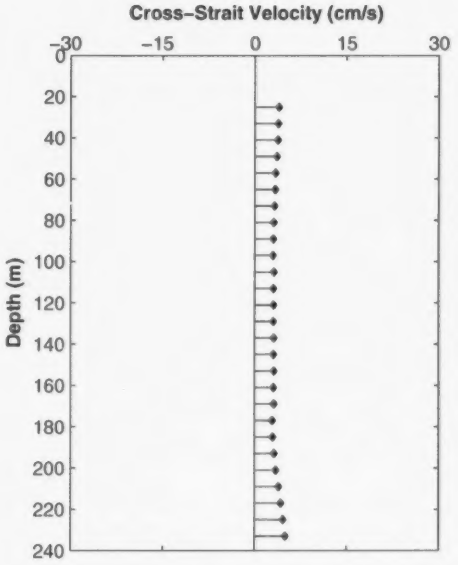


Figure 36: Mean Flows, Winter: Dec. 2005 to Mar. 2006 (continued).

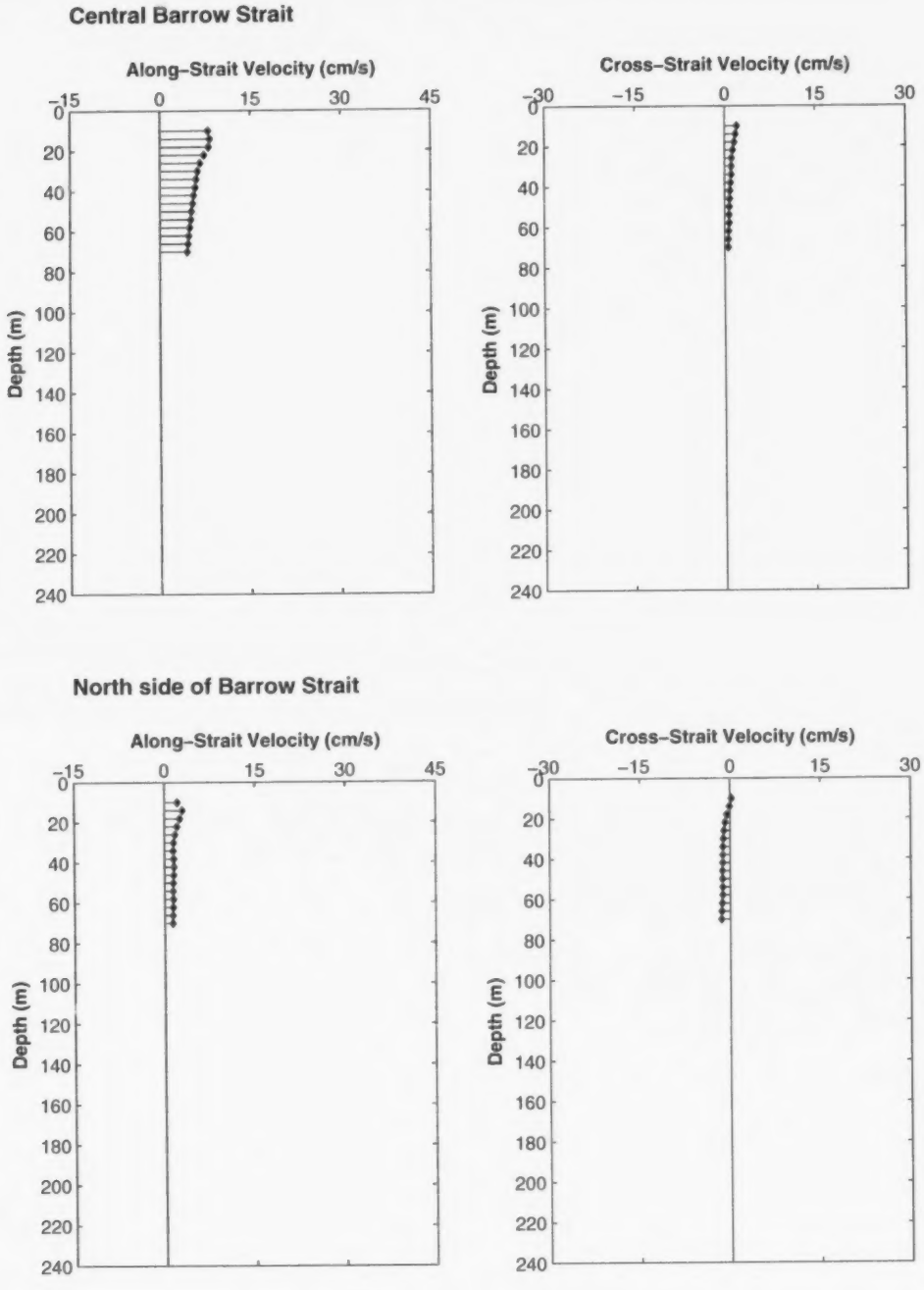
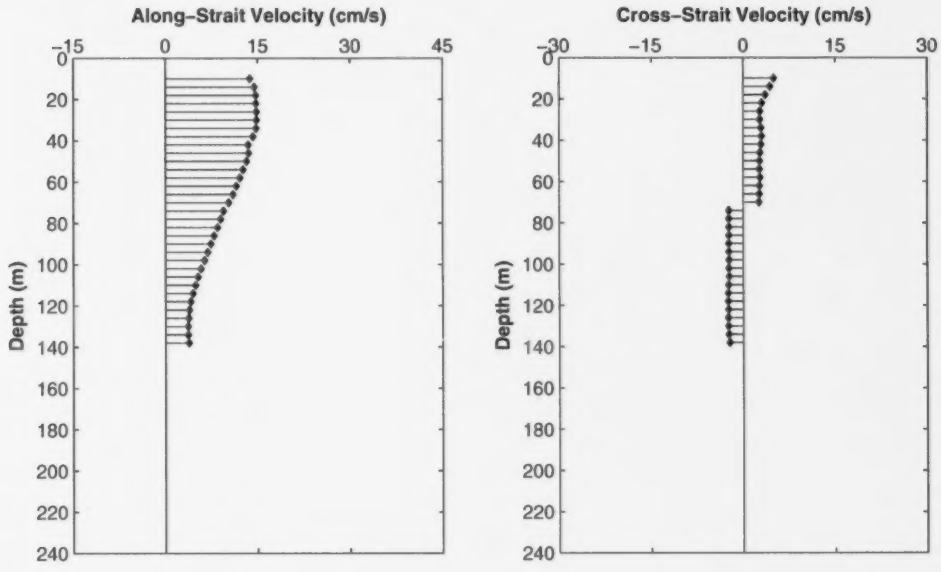


Figure 37: Mean Flows, Spring: Mar. 2006 to Jun. 2006.

South side of Barrow Strait



South–Central Barrow Strait

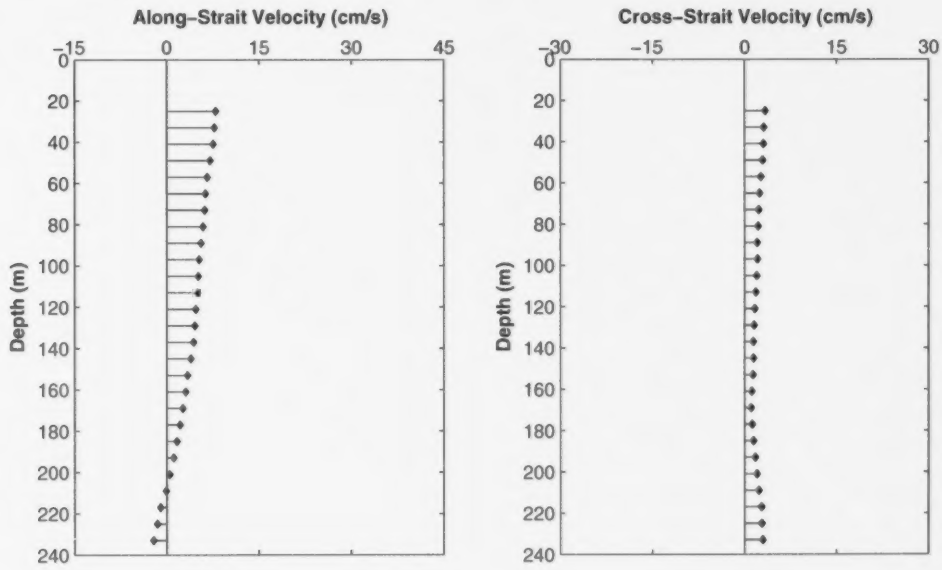
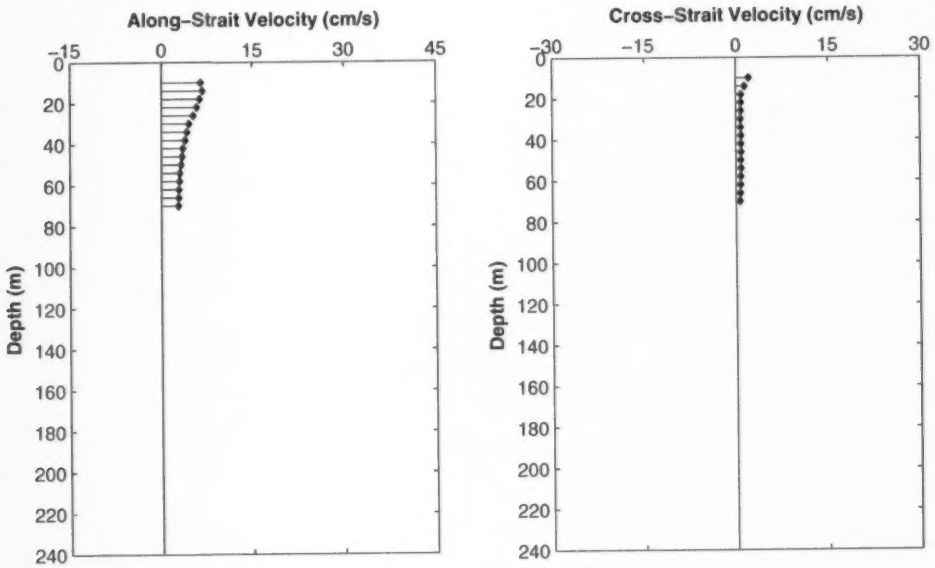


Figure 37: Mean Flows, Spring: Mar. 2006 to Jun. 2006 (continued).

Central Barrow Strait



North side of Barrow Strait

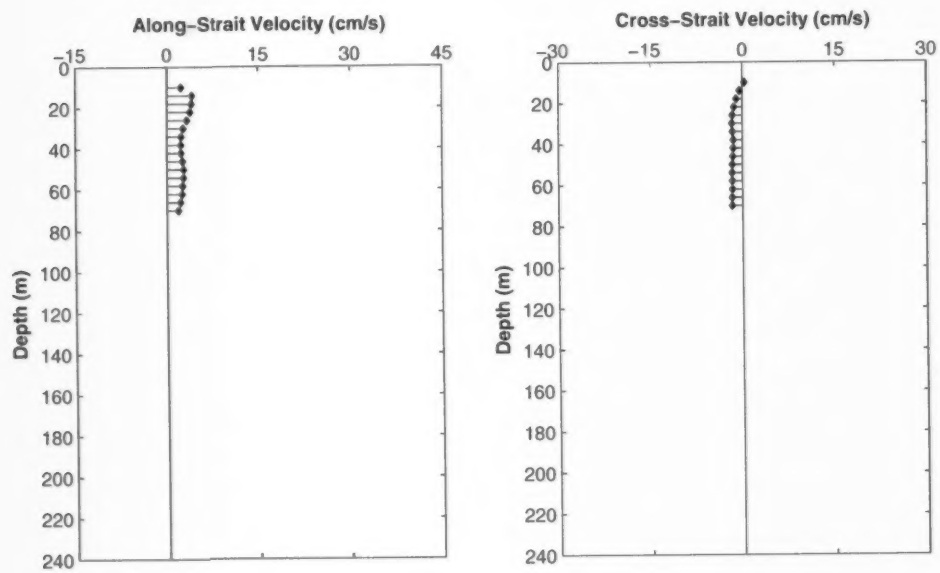
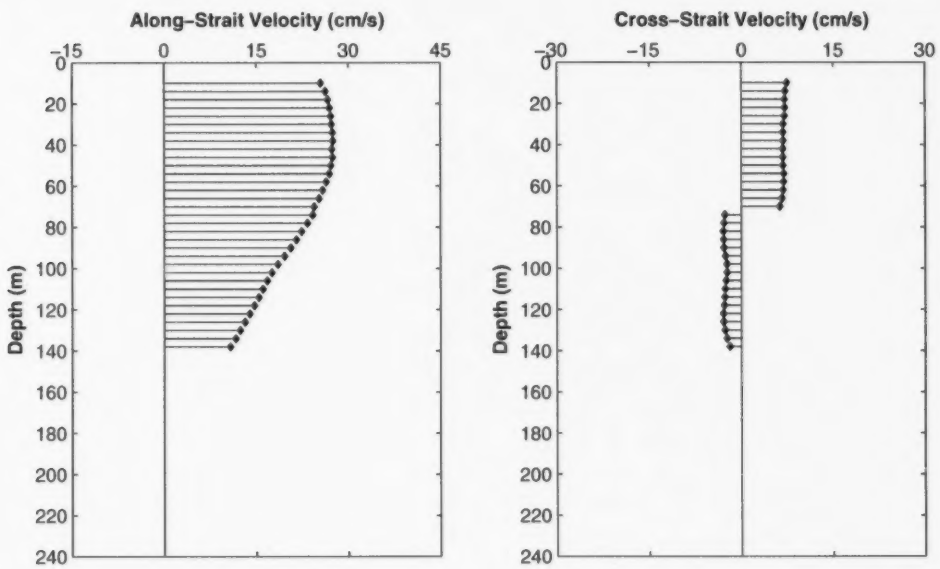


Figure 38: Mean Flows, Early Summer: Jun. 2006 to Jul. 2006.

South side of Barrow Strait



South–Central Barrow Strait

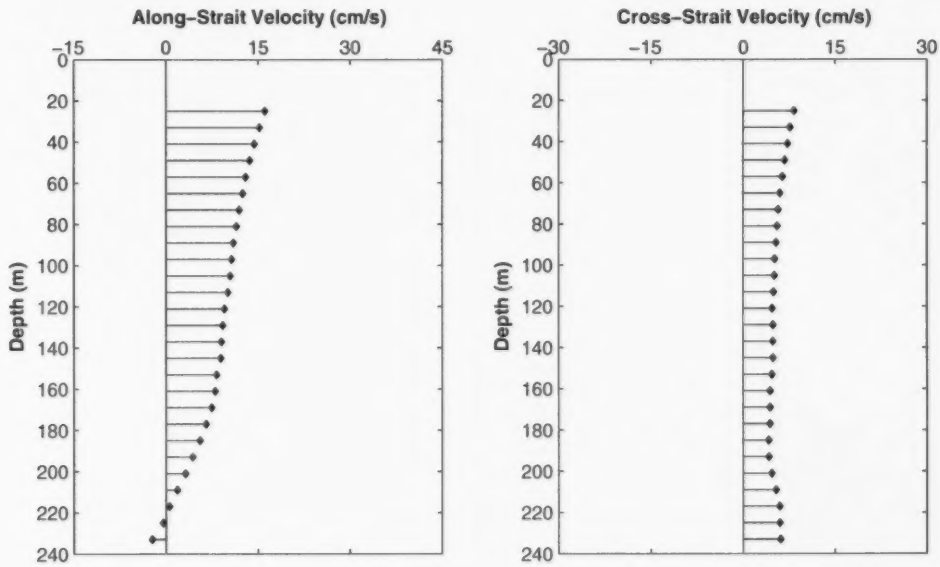


Figure 38: Mean Flows, Early Summer: Jun. 2006 to Jul. 2006 (continued).

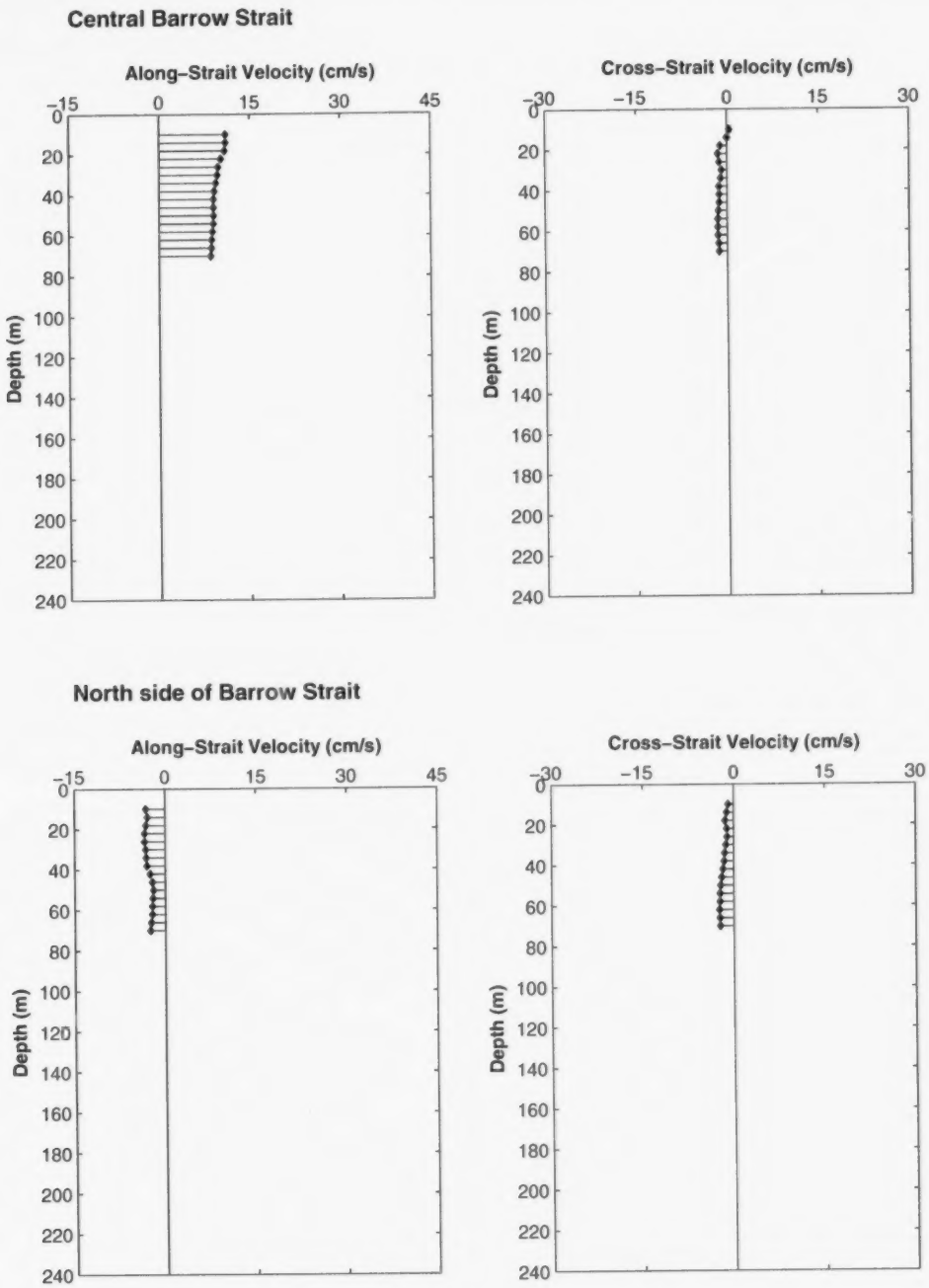


Figure 39: Variance in bi-hourly and low-pass filtered currents. Aug. 2005 to Jul. 2006.

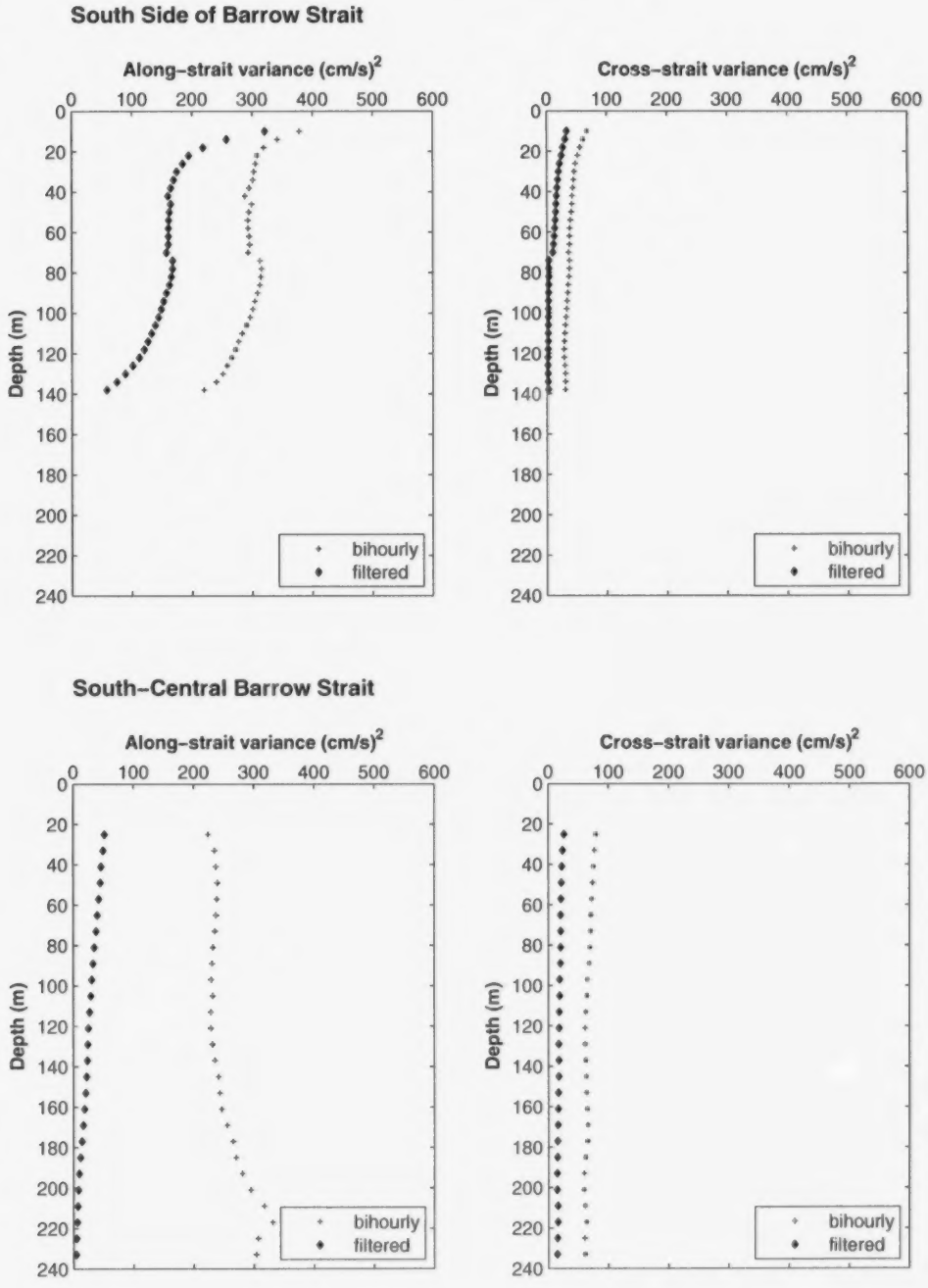


Figure 39: Variance in bi-hourly and low-pass filtered currents Aug. 2005 to Jul. 2006 (continued).

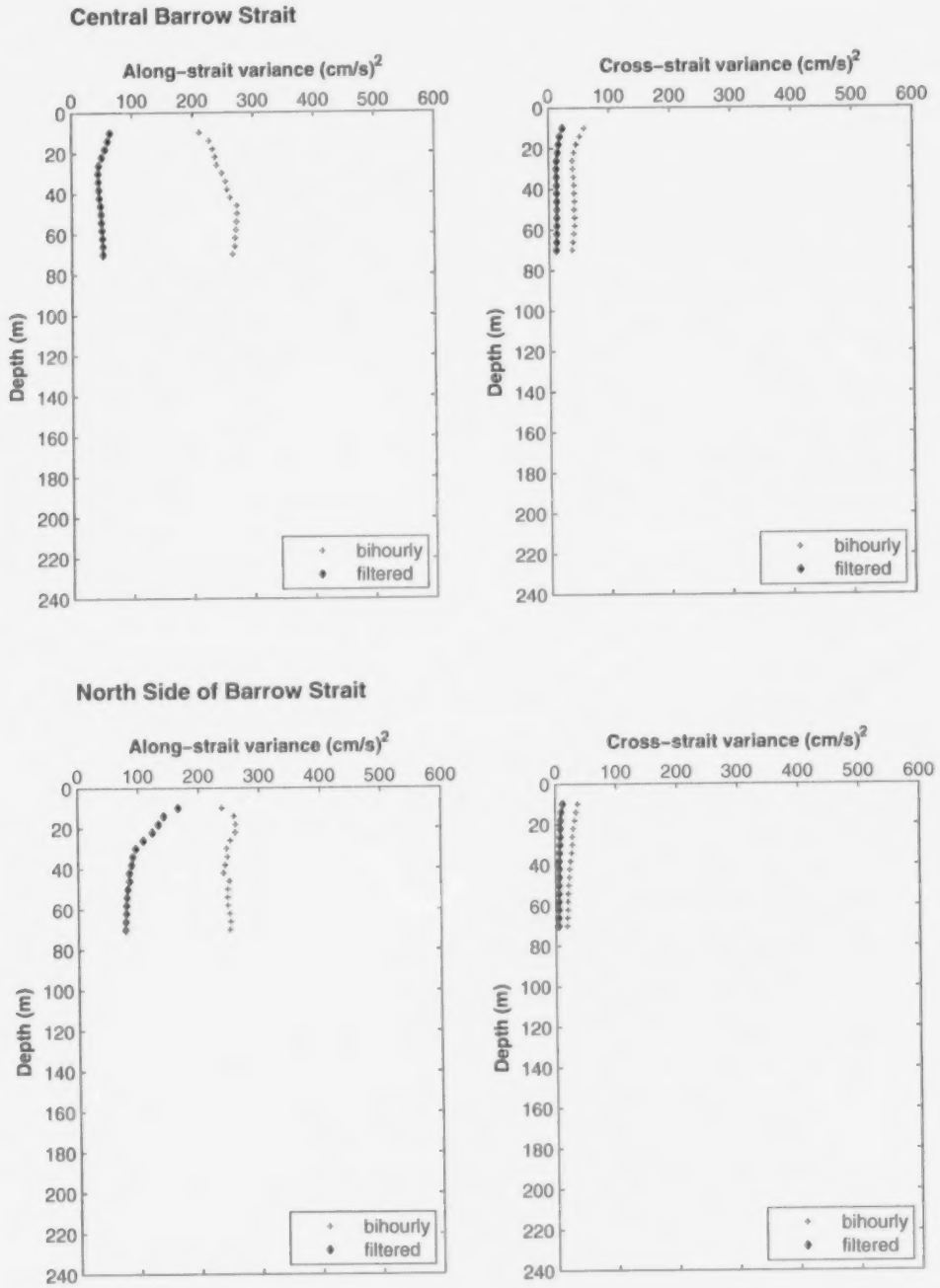
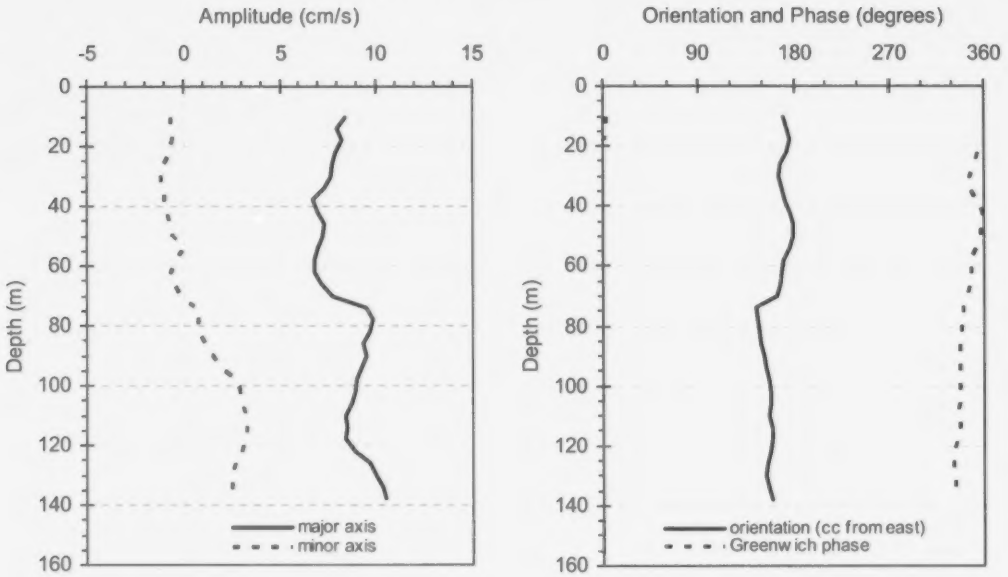


Figure 40 – K1 Tidal Constituent, South Side of Barrow Strait

For Ice Free Period (Aug. 09, 2005 to Oct. 2, 2005):



For Solid Ice Period (Jan. 21, 2006 to Jun 28, 2006):

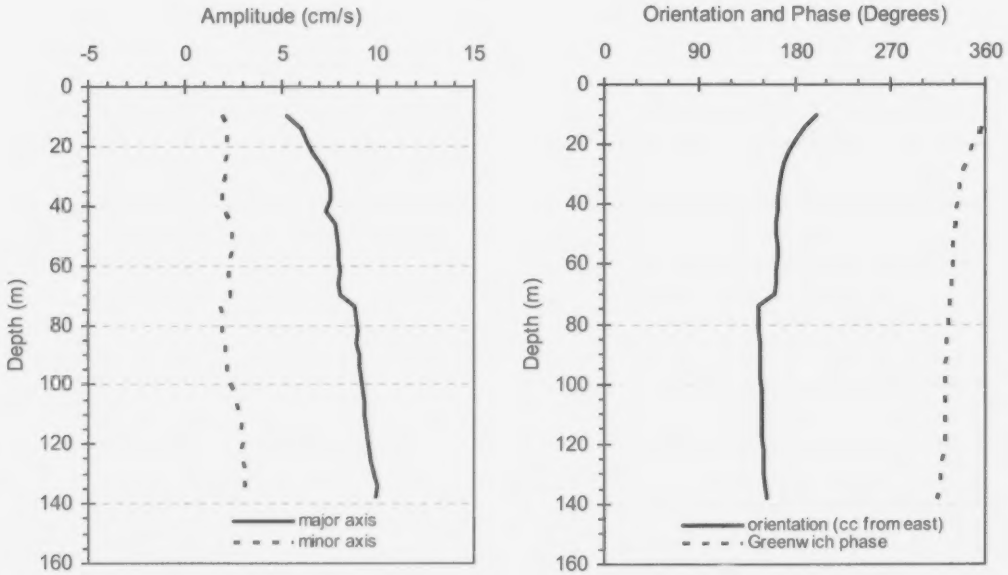
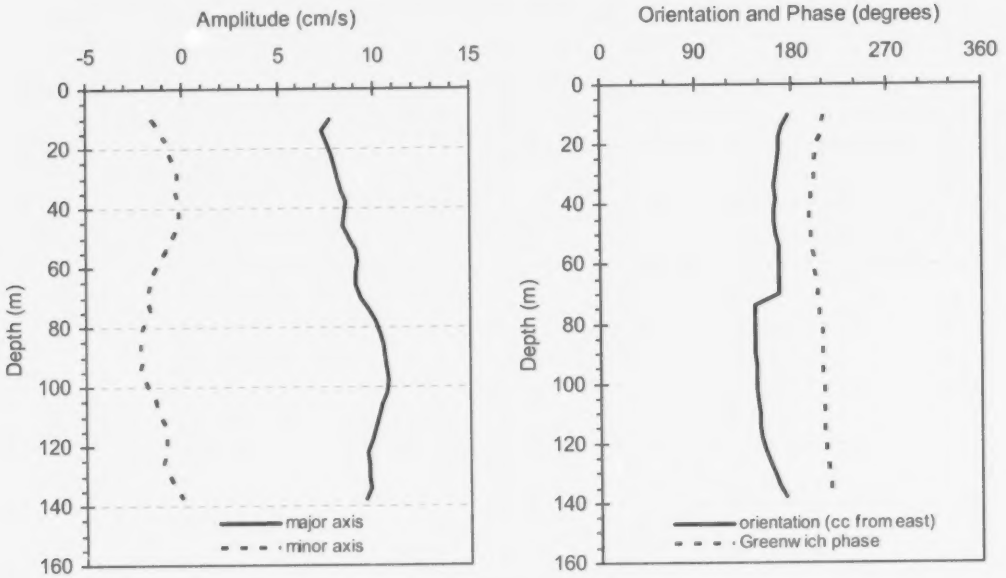


Figure 41 – M2 Tidal Constituent, South Side of Barrow Strait

For Ice Free Period (Aug. 9, 2005 to Oct. 2, 2005):



For Solid Ice Period (Jan. 21, 2006 to Jun. 28, 2006):

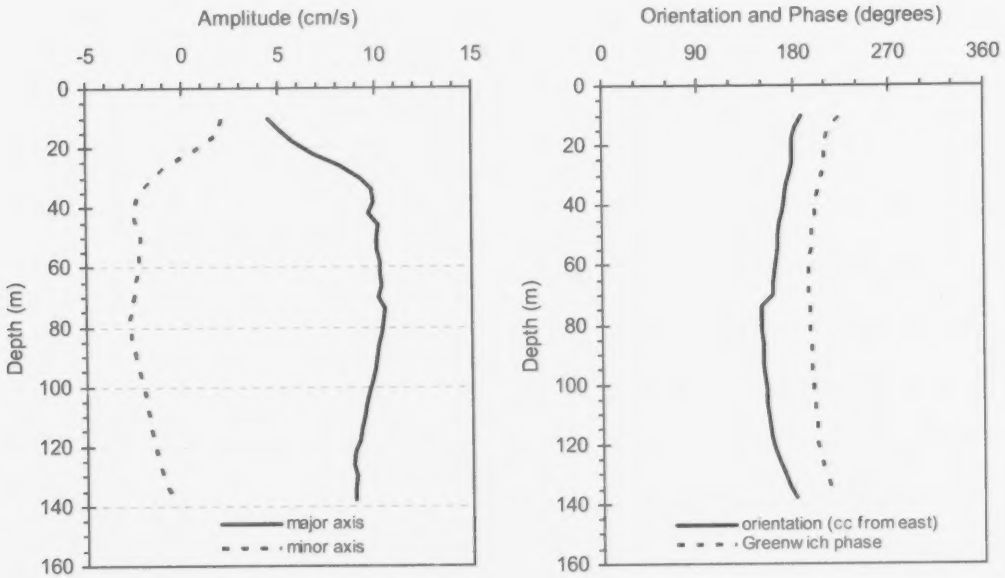
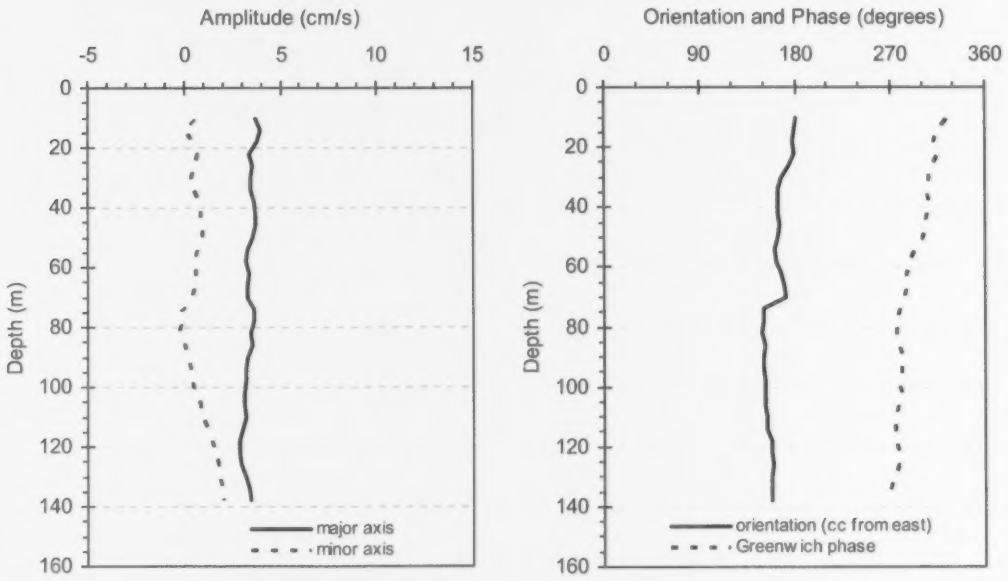


Figure 42 – O1 Tidal Constituent, South Side of Barrow Strait

For Ice Free Period (Aug. 09, 2005 to Oct. 2, 2005):



For Solid Ice Period (Jan. 21, 2006 to Jun, 28, 2006):

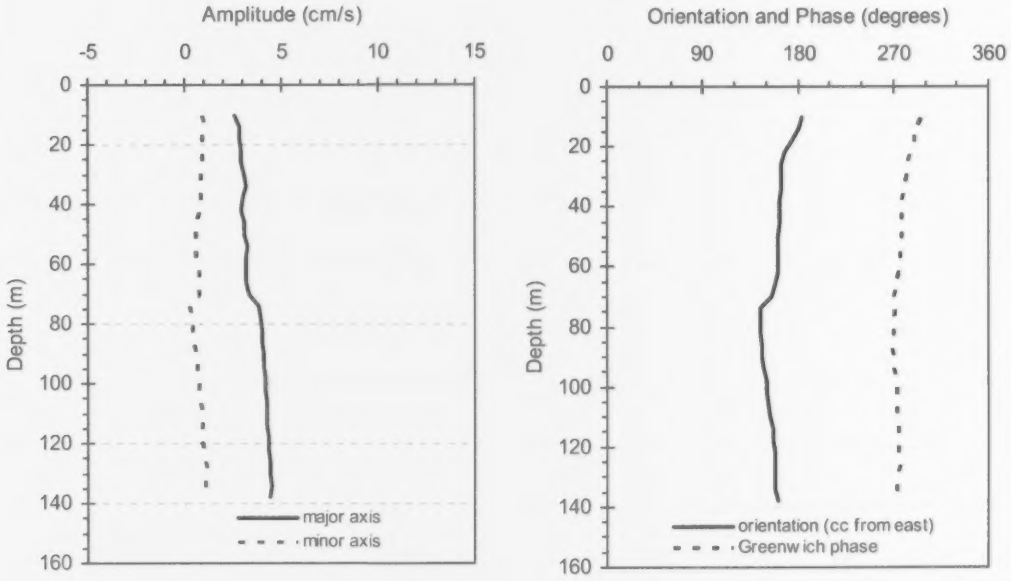
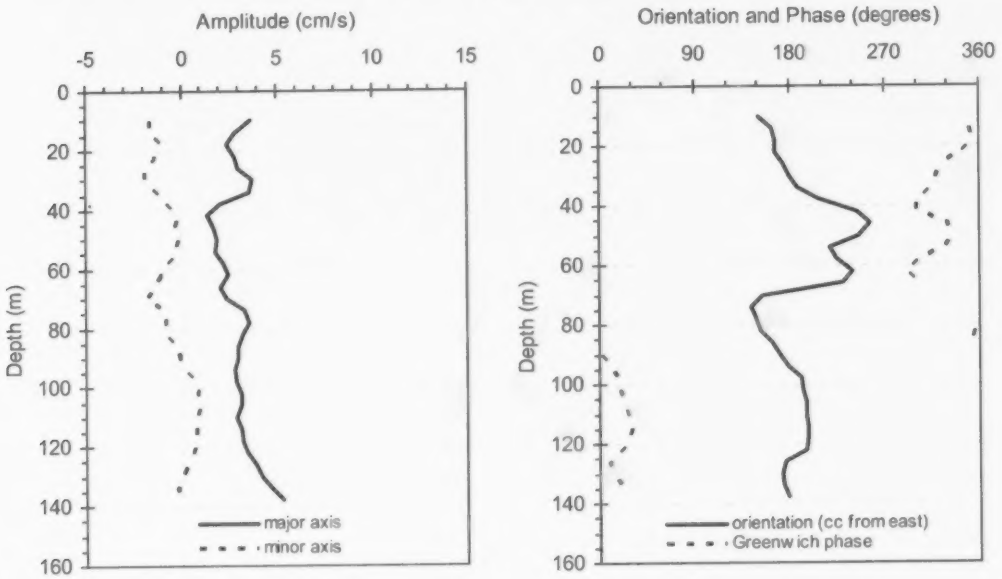


Figure 43 – P1 Tidal Constituent, South Side of Barrow Strait

For Ice Free Period (Aug. 09, 2005 to Oct. 2, 2005):



For Solid Ice Period (Jan. 21, 2006 to Jun. 28, 2006):

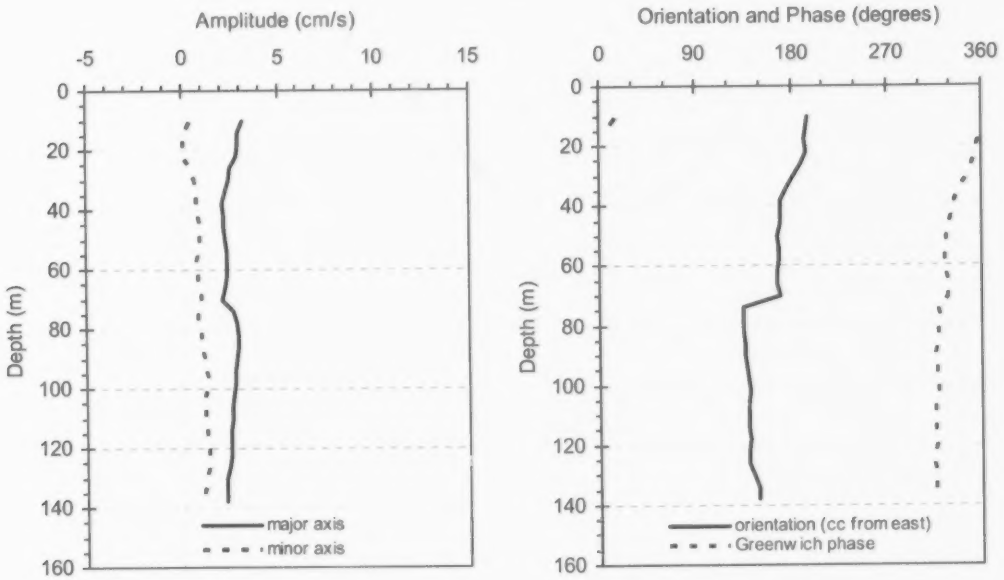
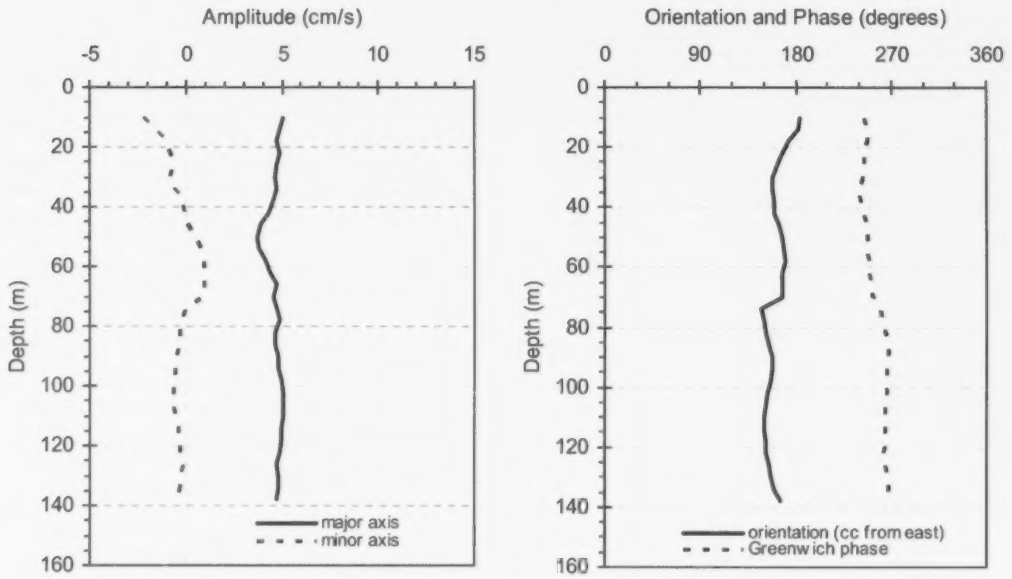


Figure 44 – S2 Tidal Constituent, South Side of Barrow Strait

For Ice Free Period (Aug. 09, 2005 to Oct. 02, 2005):



For Solid Ice Period (Jan. 21, 2006 to Jun. 28, 2006):

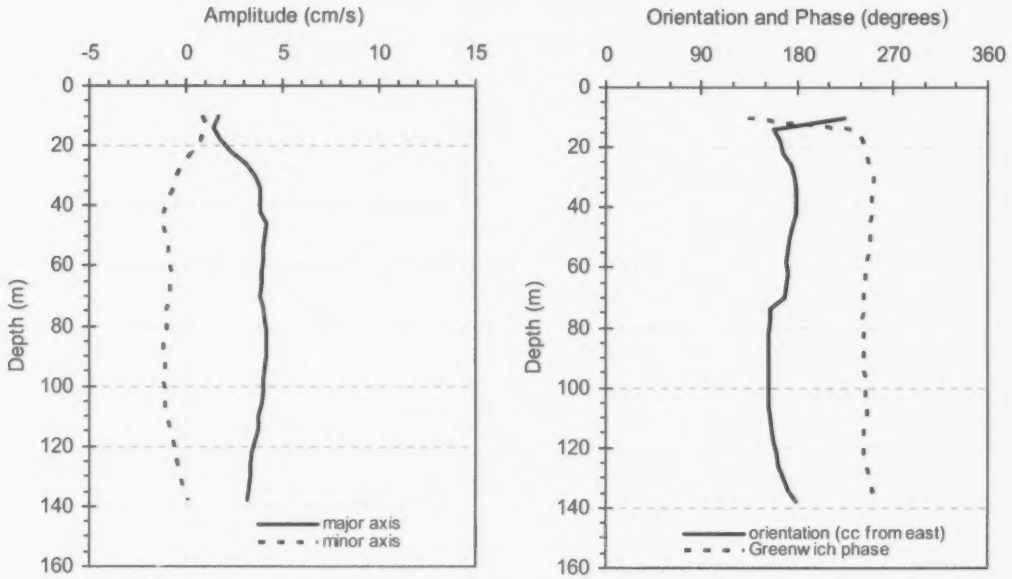
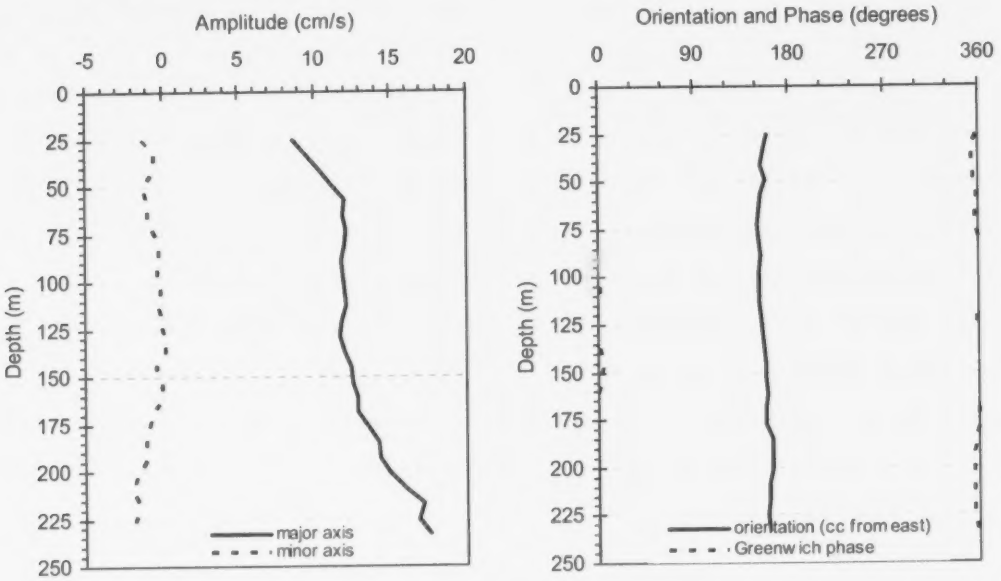


Figure 45 - K1 Tidal Constituent, South Central Barrow Strait

For Ice Free Period (Aug. 10, 2005 to Oct. 02, 2005):



For Solid Ice Period (Jan. 21, 2006 to Jun 28, 2006):

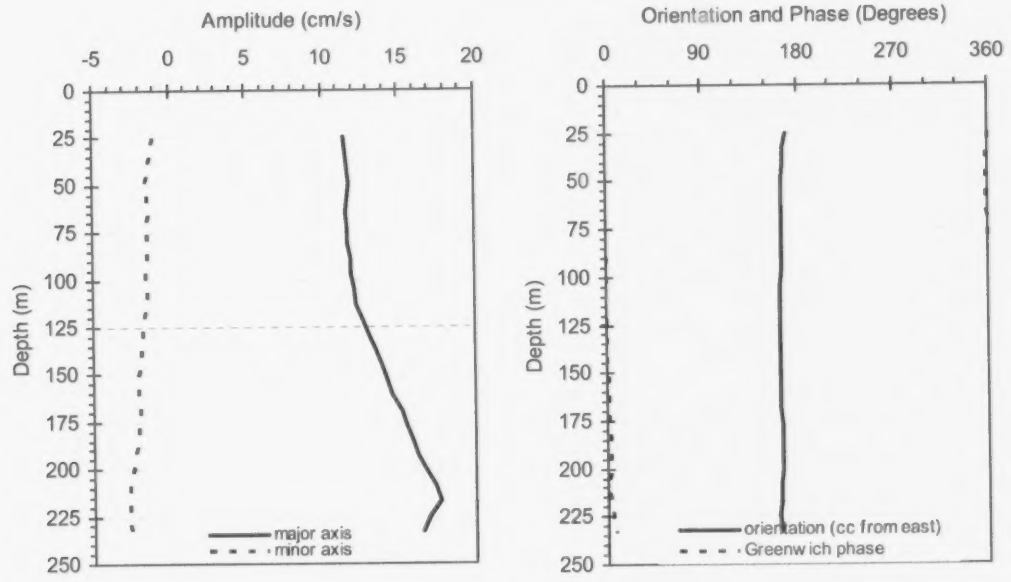
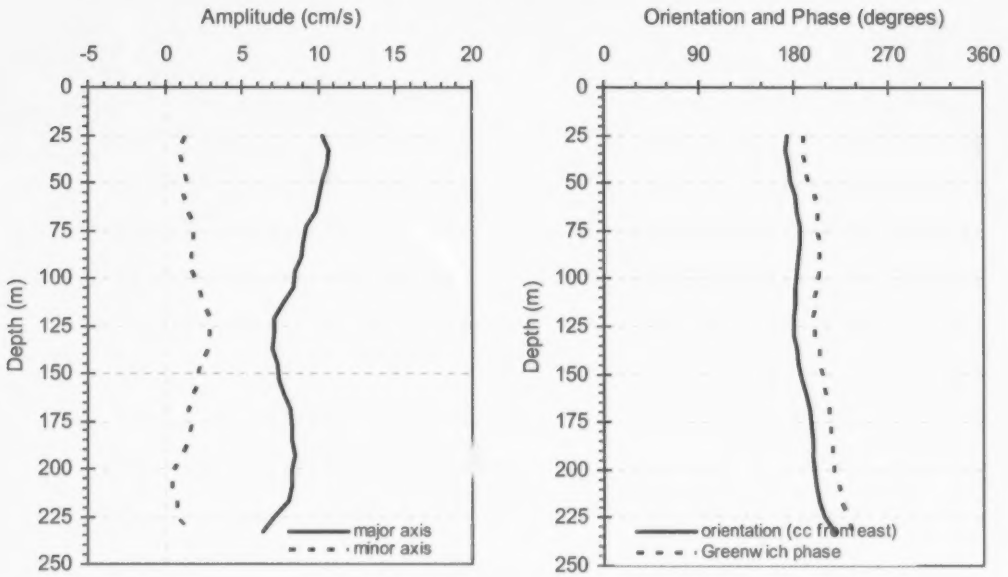


Figure 46 – M2 Tidal Constituent, South Central Barrow Strait

For Ice Free Period (Aug. 10, 2005 to Oct. 02, 2005):



For Solid Ice Period (Jan. 21, 2006 to Jun. 28, 2006):

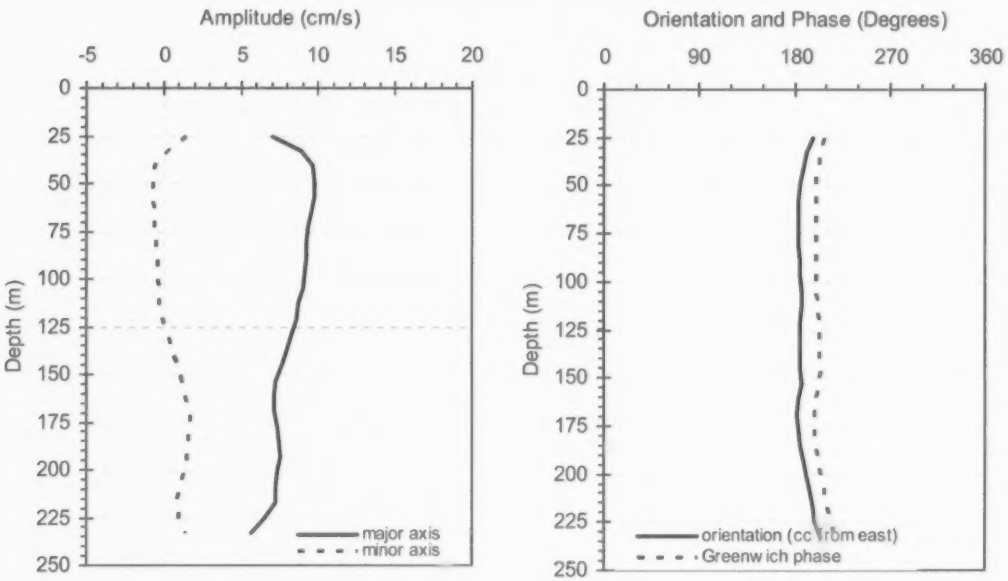
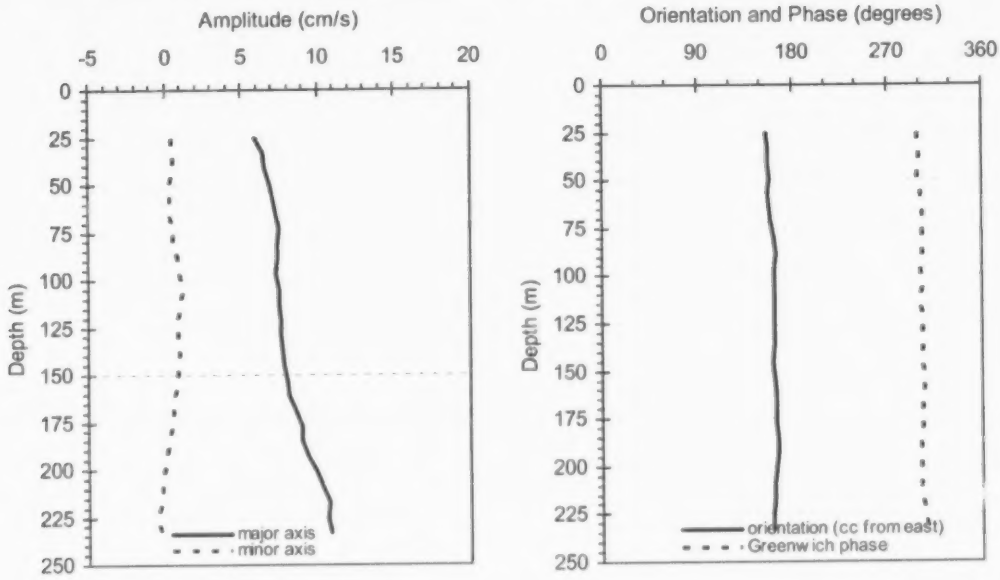


Figure 47 – O1 Tidal Constituent, South Central Barrow Strait

For Ice Free Period (Aug. 10, 2005 to Oct. 02, 2005):



For Solid Ice Period (Jan. 21, 2006 to Jun. 28, 2006):

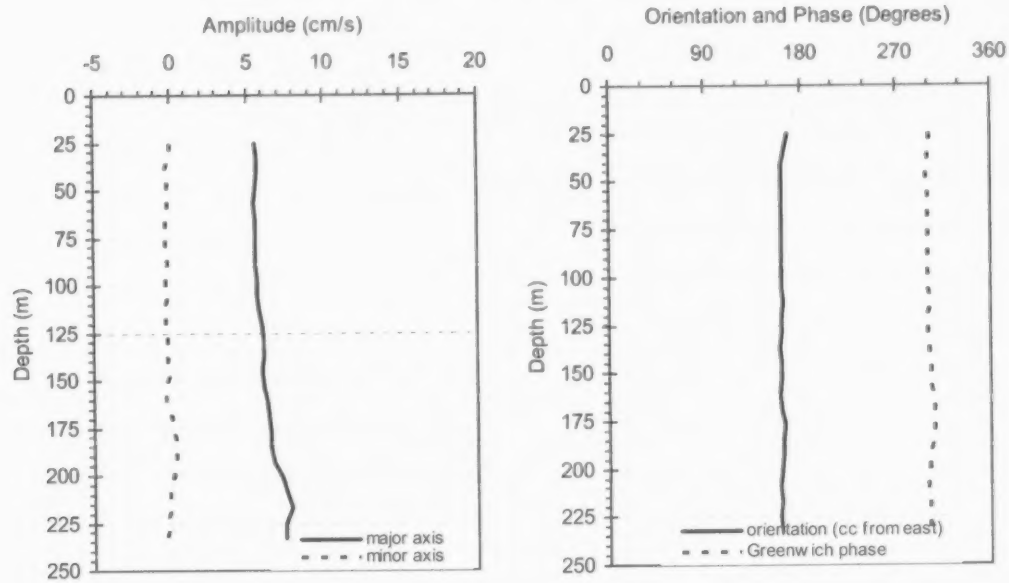
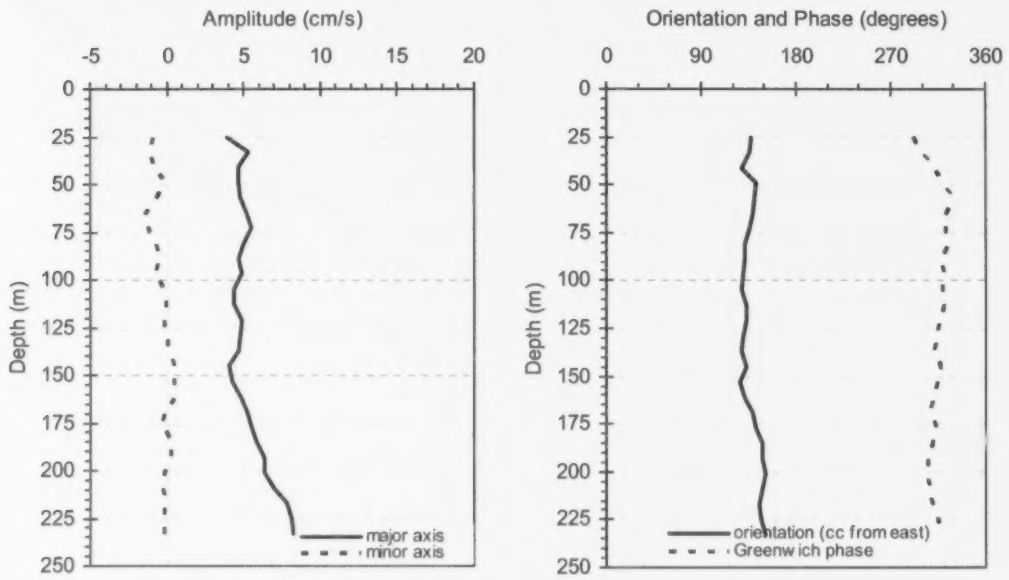


Figure 48 – P1 Tidal Constituent, South Central Barrow Strait

For Ice Free Period (Aug. 10, 2005 to Oct. 2, 2005):



For Solid Ice Period (Jan. 21, 2006 to Jun. 28, 2006):

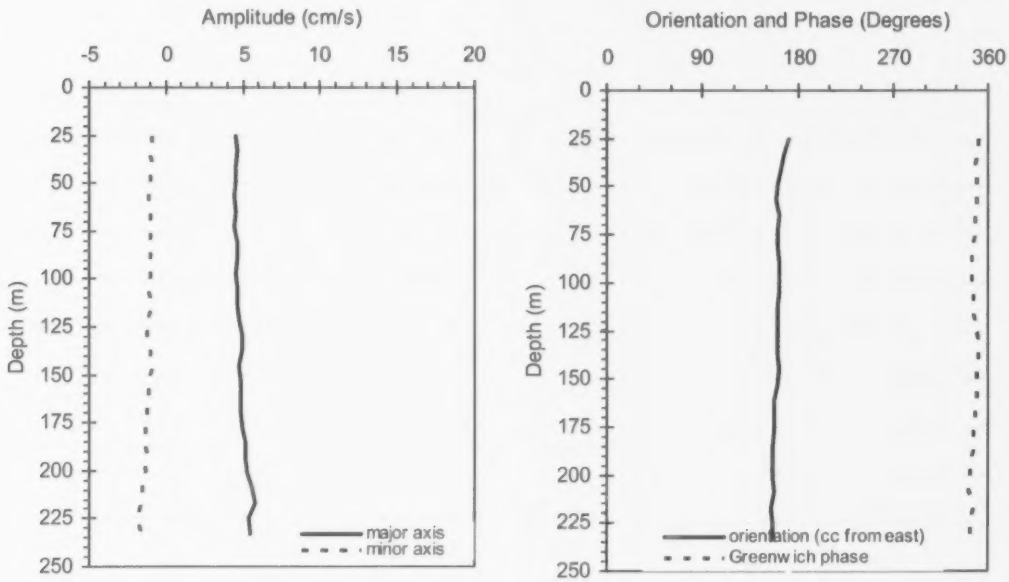
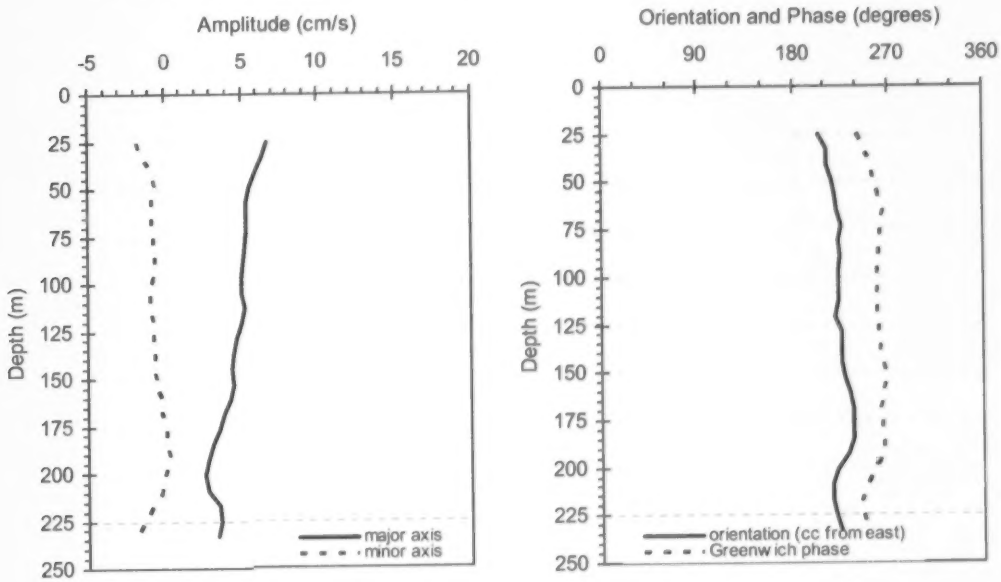


Figure 49 – S2 Tidal Constituent, South Central Barrow Strait

For Ice Free Period (Aug. 10, 2005 to Oct. 02, 2005):



For Solid Ice Period (Jan. 21, 2006 to Jun. 28, 2006):

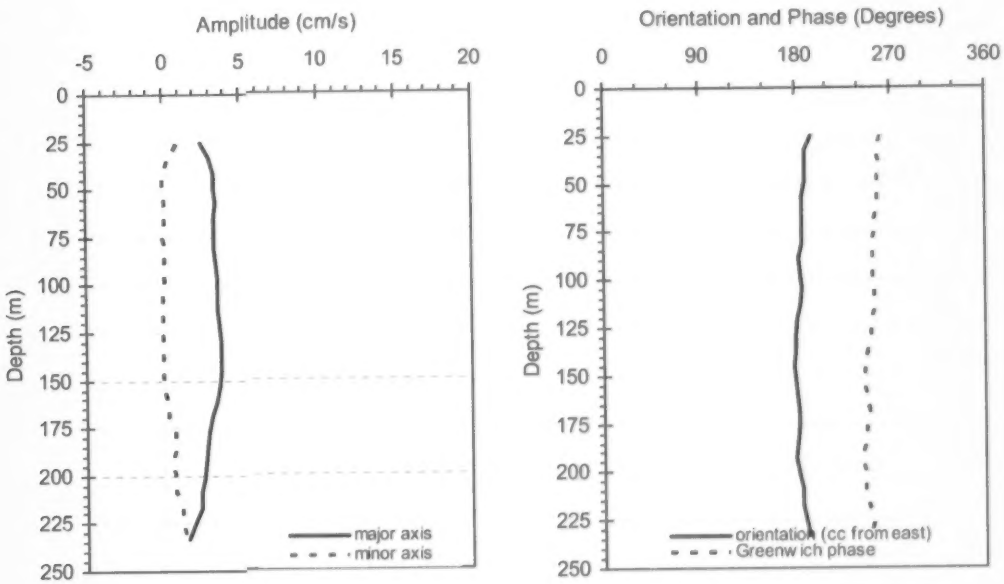
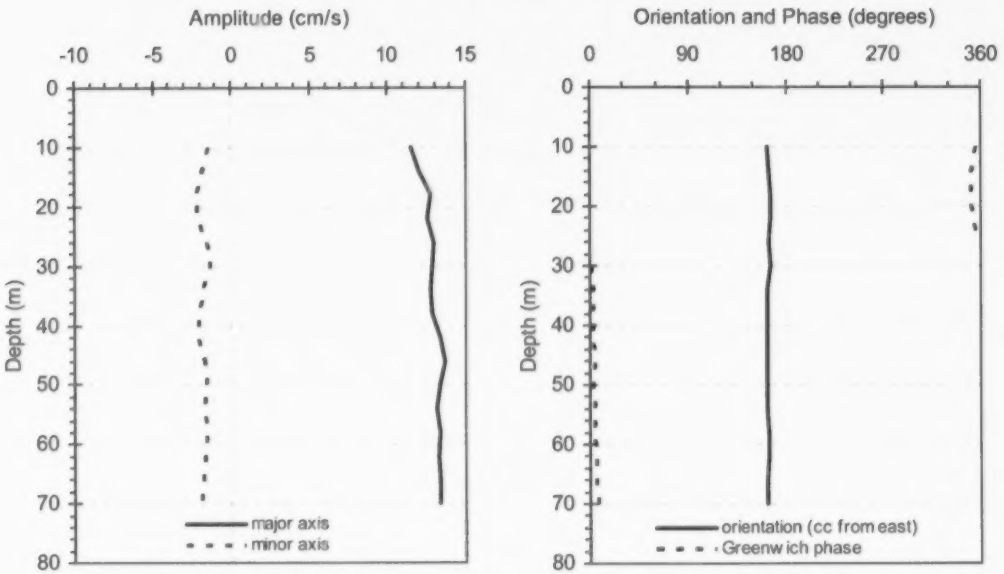


Figure 50 – K1 Tidal Constituent, Central Barrow Strait

For Ice Free Period (Aug. 10, 2005 to Oct. 06, 2005):



For Solid Ice Period (Jan. 21, 2006 to Jun. 28, 2006):

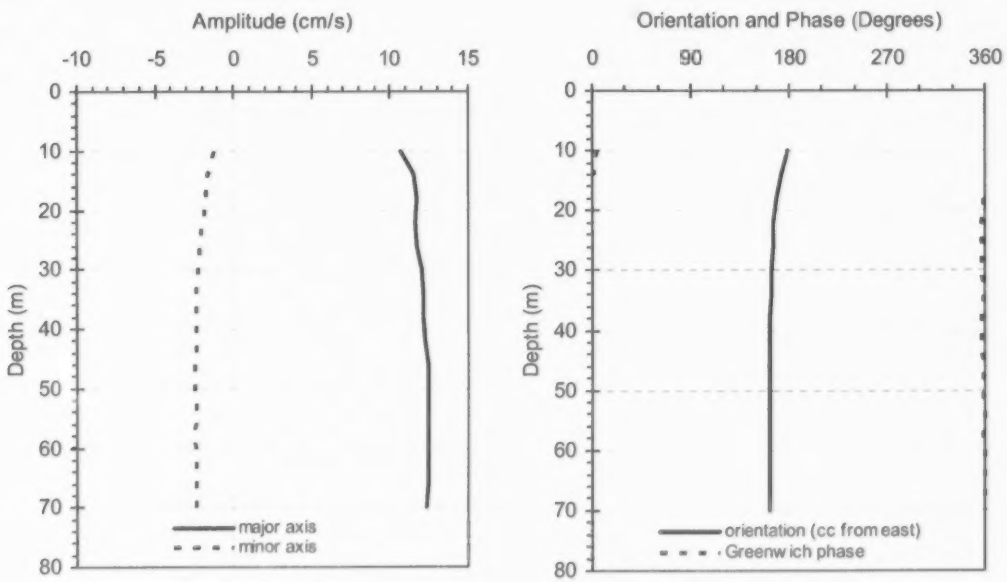
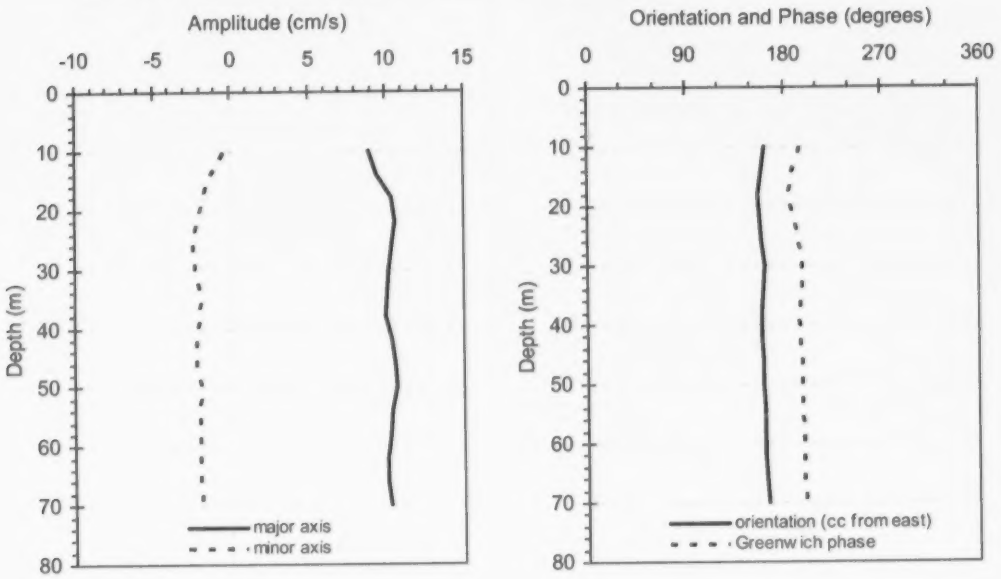


Figure 51 – M2 Tidal Constituent, Central Barrow Strait

For Ice Free Period (Aug. 10, 2005 to Oct. 06, 2005):



For Solid Ice Period (Jan. 21, 2006 to Jun. 28, 2006):

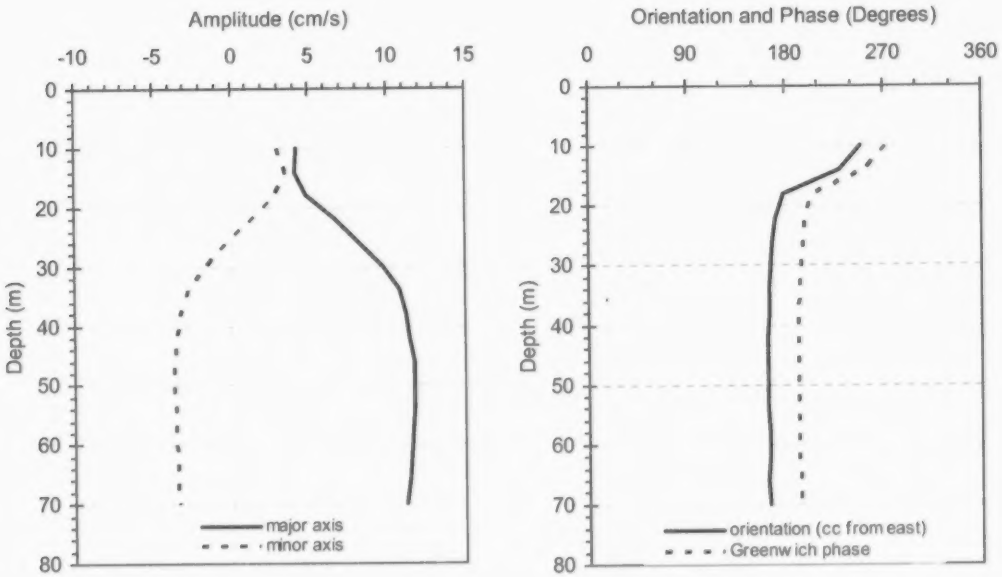
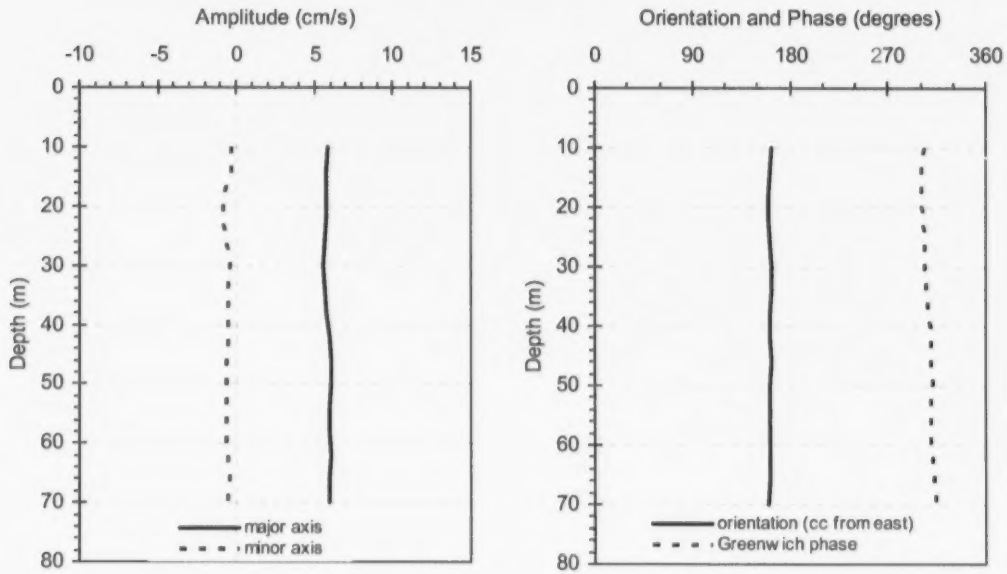


Figure 52 – O1 Tidal Constituent, Central Barrow Strait

For Ice Free Period (Aug. 10, 2005 to Oct. 06, 2005):



For Solid Ice Period (Jan. 21, 2006 to Jun. 28, 2006):

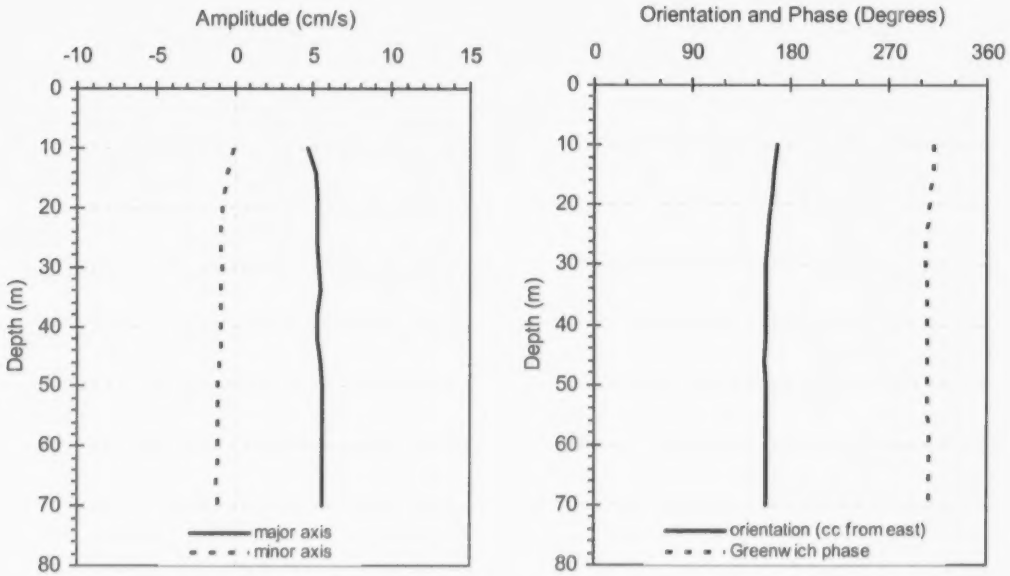
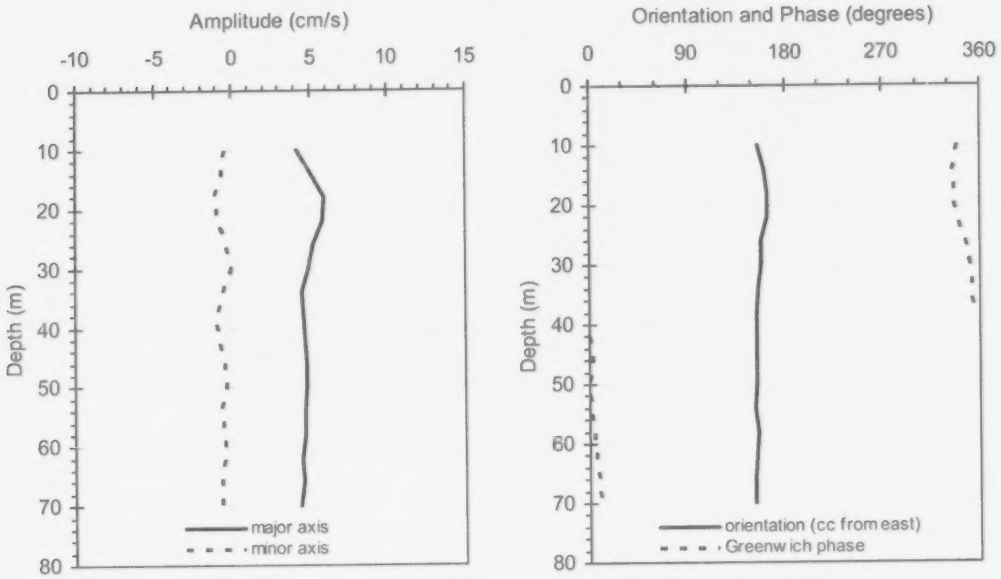


Figure 53 – P1 Tidal Constituent, Central Barrow Strait

For Ice Free Period (Aug. 10, 2005 to Oct. 06, 2005):



For Solid Ice Period (Jan. 21, 2006 to Jun. 28, 2006):

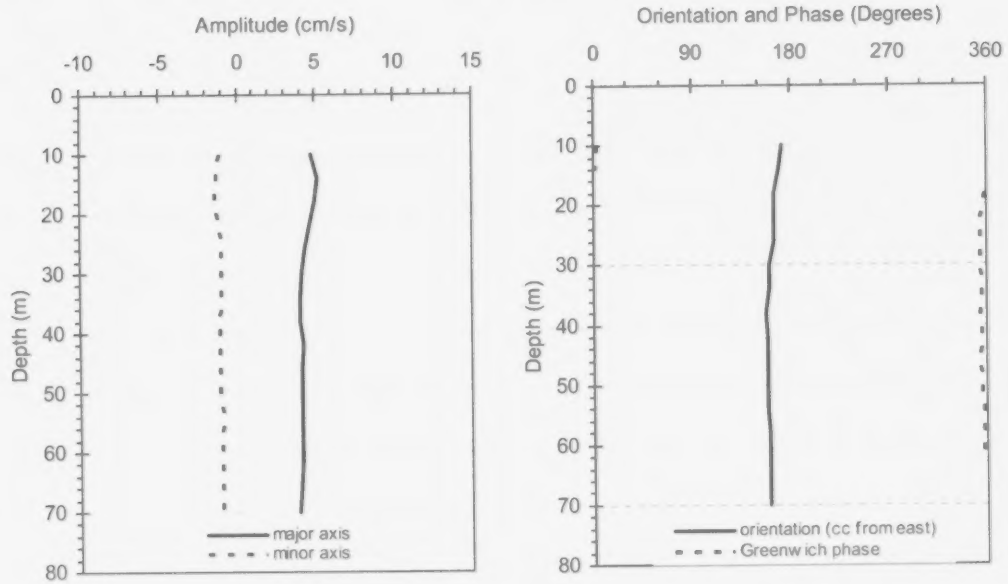
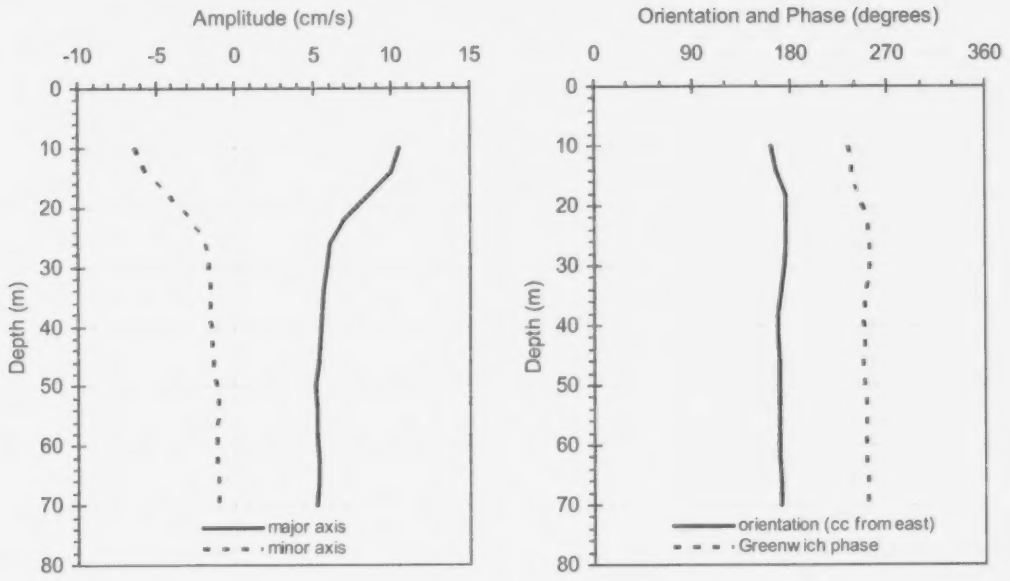


Figure 54 – S2 Tidal Constituent, Central Barrow Strait

For Ice Free Period (Aug. 10, 2005 to Oct. 06, 2005):



For Solid Ice Period (Jan. 21, 2006 to Jun. 28, 2006):

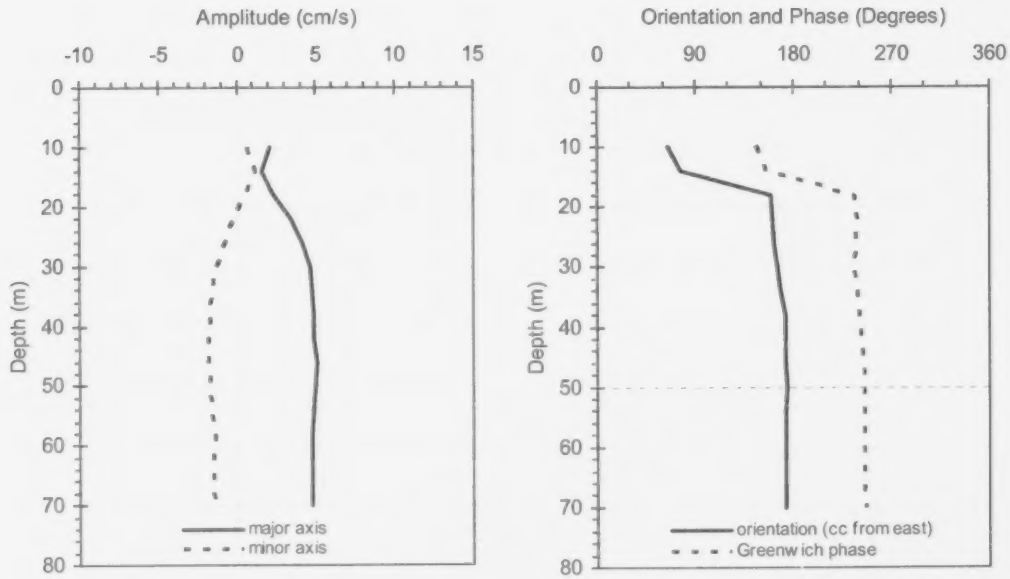
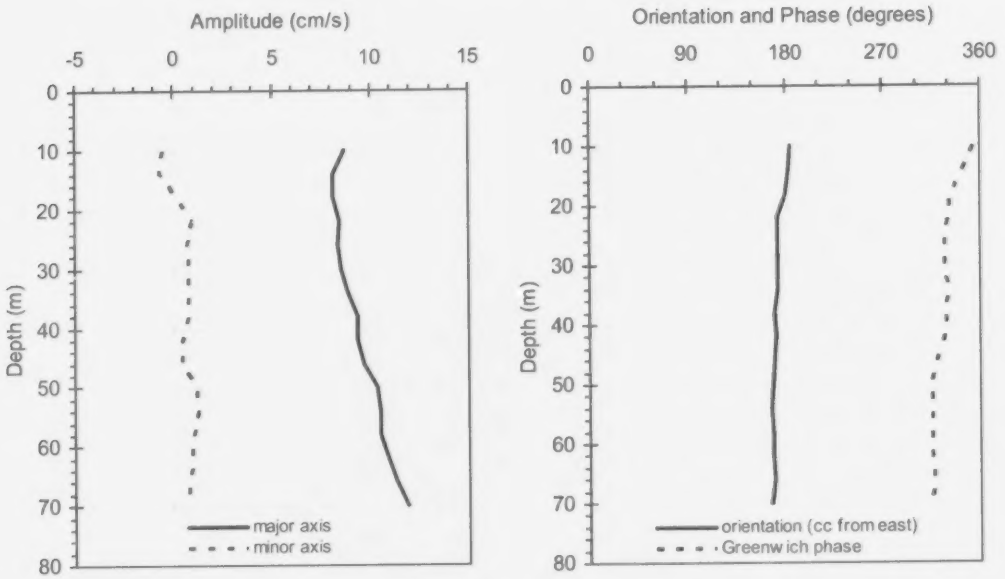


Figure 55 – K1 Tidal Constituent, North Side of Barrow Strait

For Ice Free Period (Aug. 10, 2005 to Oct. 06, 2005):



For Solid Ice Period (Jan. 21, 2006 to Jun. 28, 2006):

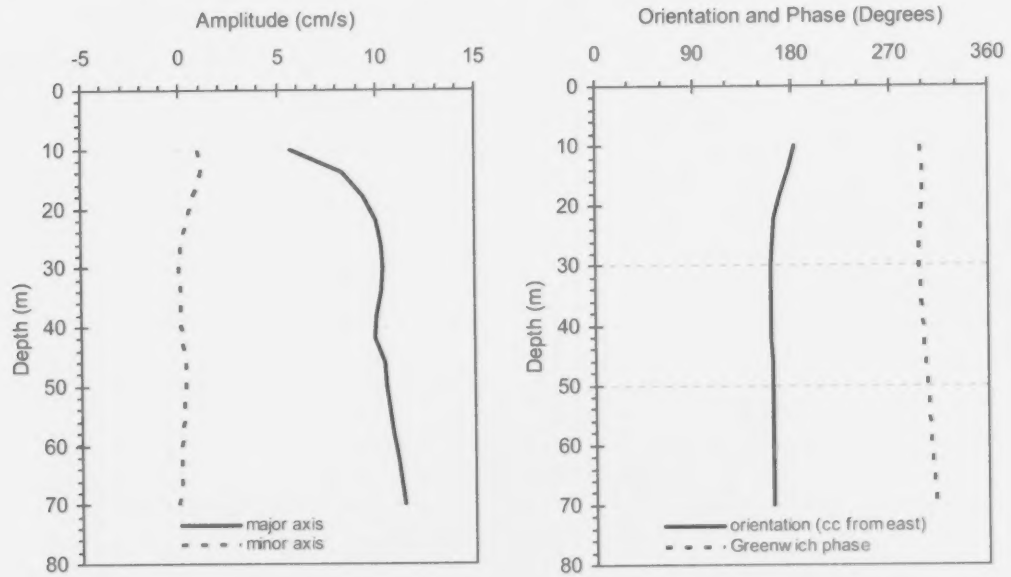
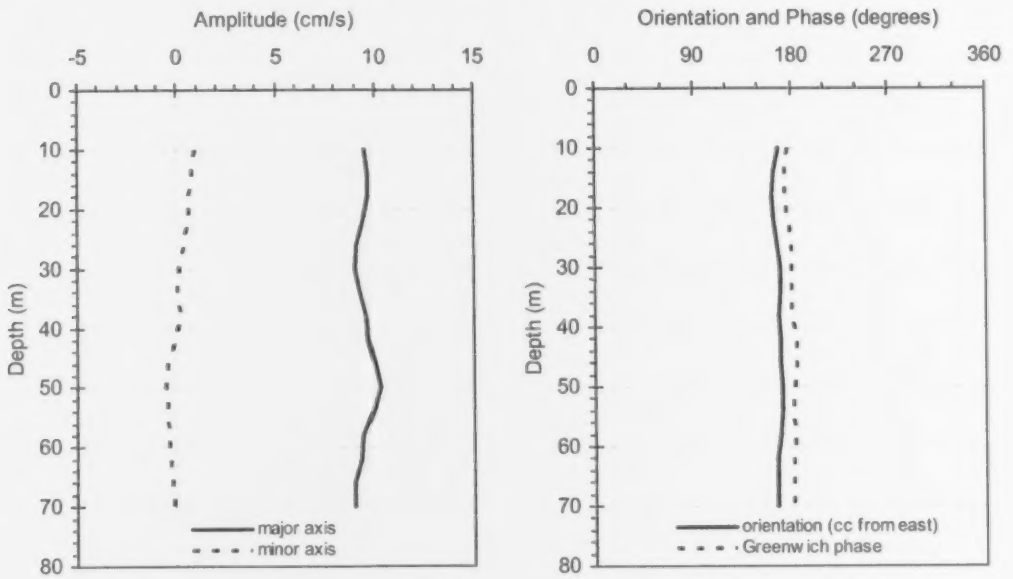


Figure 56– M2 Tidal Constituent, North Side of Barrow Strait

For Ice Free Period (Aug. 10, 2005 to Oct. 6, 2005):



For Solid Ice Period (Jan. 21, 2006 to Jun. 28, 2006):

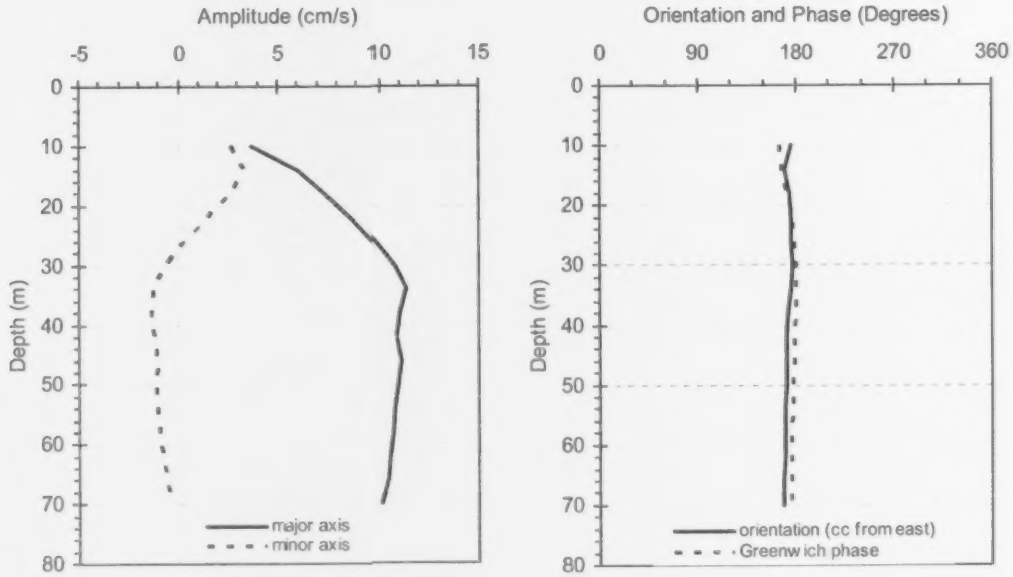
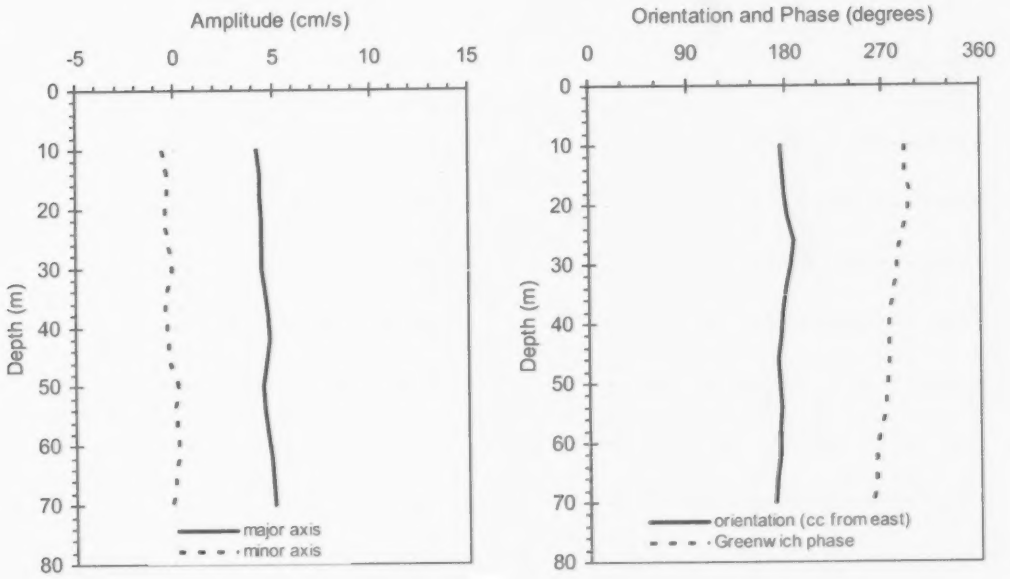


Figure 57 – O1 Tidal Constituent, North Side of Barrow Strait

For Ice Free Period (Aug. 10, 2005 to Oct. 06, 2005):



For Solid Ice Period (Jan. 21, 2006 to Jun. 28, 2006):

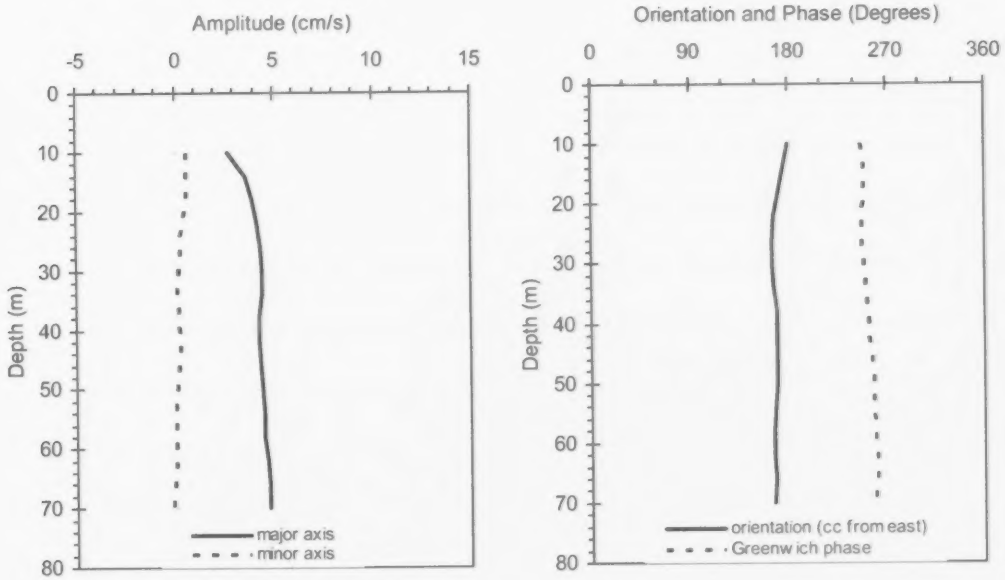
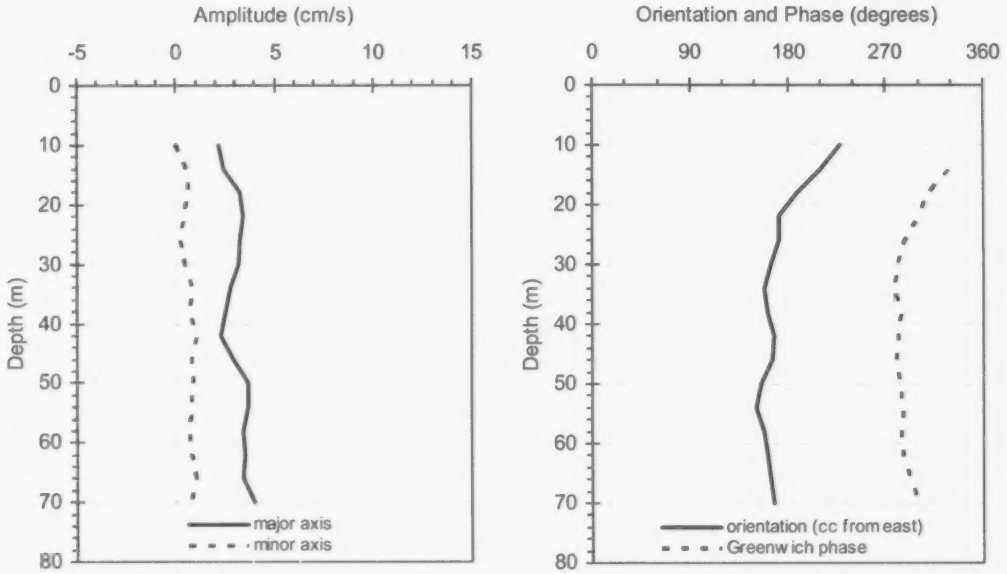


Figure 58 – P1 Tidal Constituent, North Side of Barrow Strait

For Ice Free Period (Aug. 10, 2005 to Oct. 6, 2005):



For Solid Ice Period (Jan. 21, 2006 to Jun. 28, 2006):

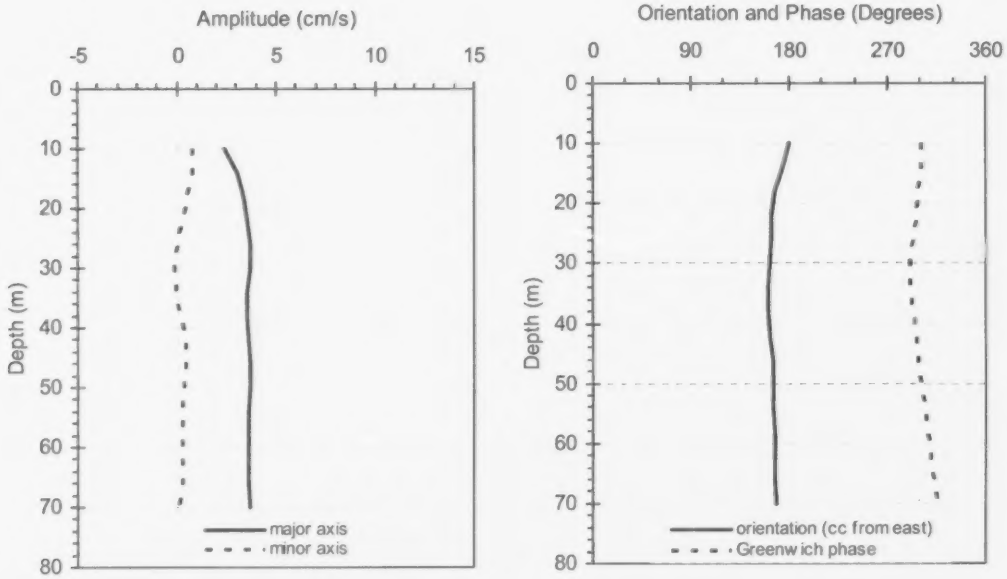
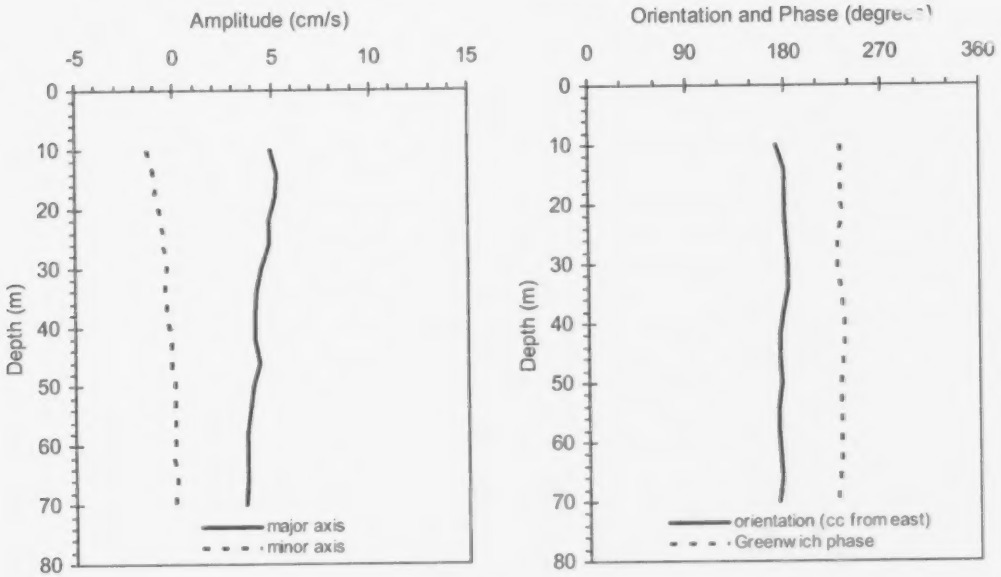


Figure 59 – S2 Tidal Constituent, North Side of Barrow Strait

For Ice Free Period (Aug. 10, 2005 to Oct. 06, 2005):



For Solid Ice Period (Jan. 21, 2006 to Jun. 28, 2006):

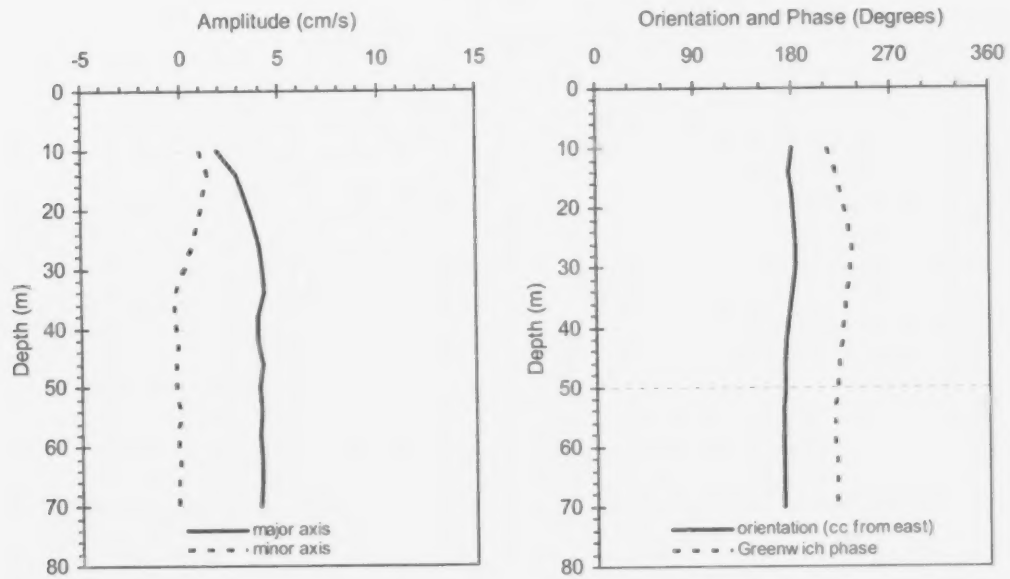


Figure 60 - Ice velocity data, South side of Barrow Strait
August 2005 – July 2006

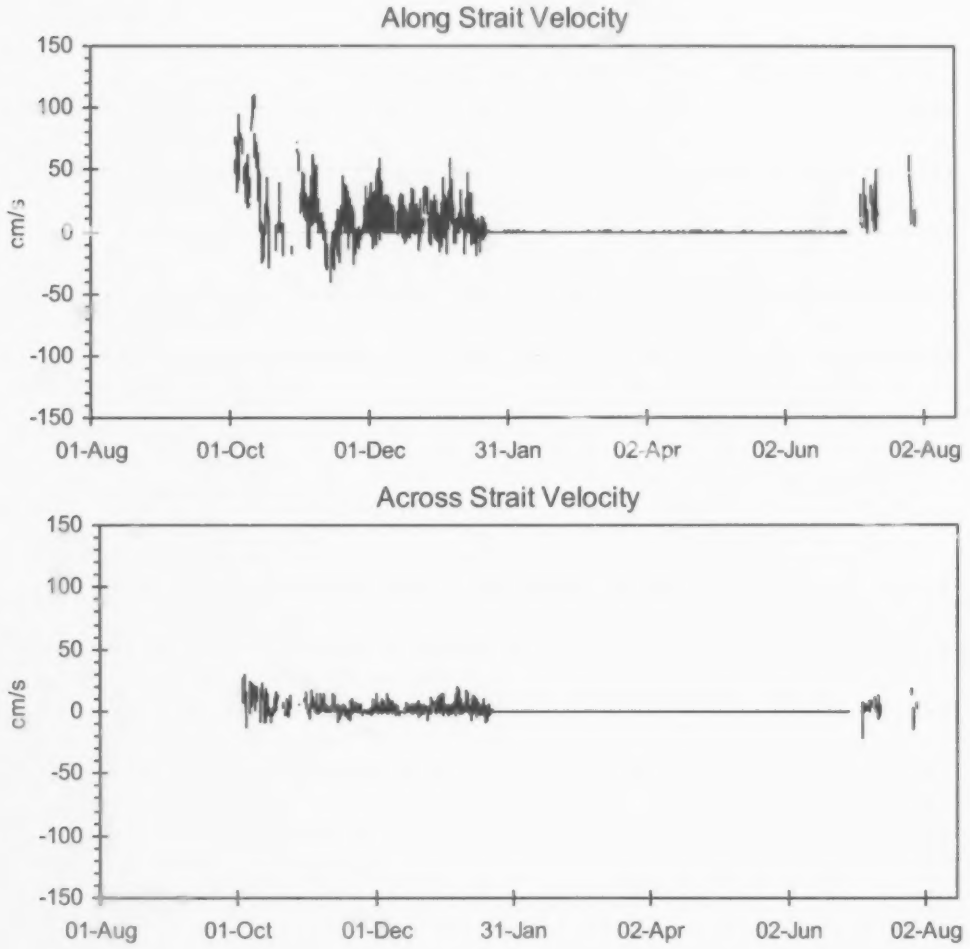


Figure 61 - Ice velocity data, South Central Barrow Strait
August 2005 – July 2006

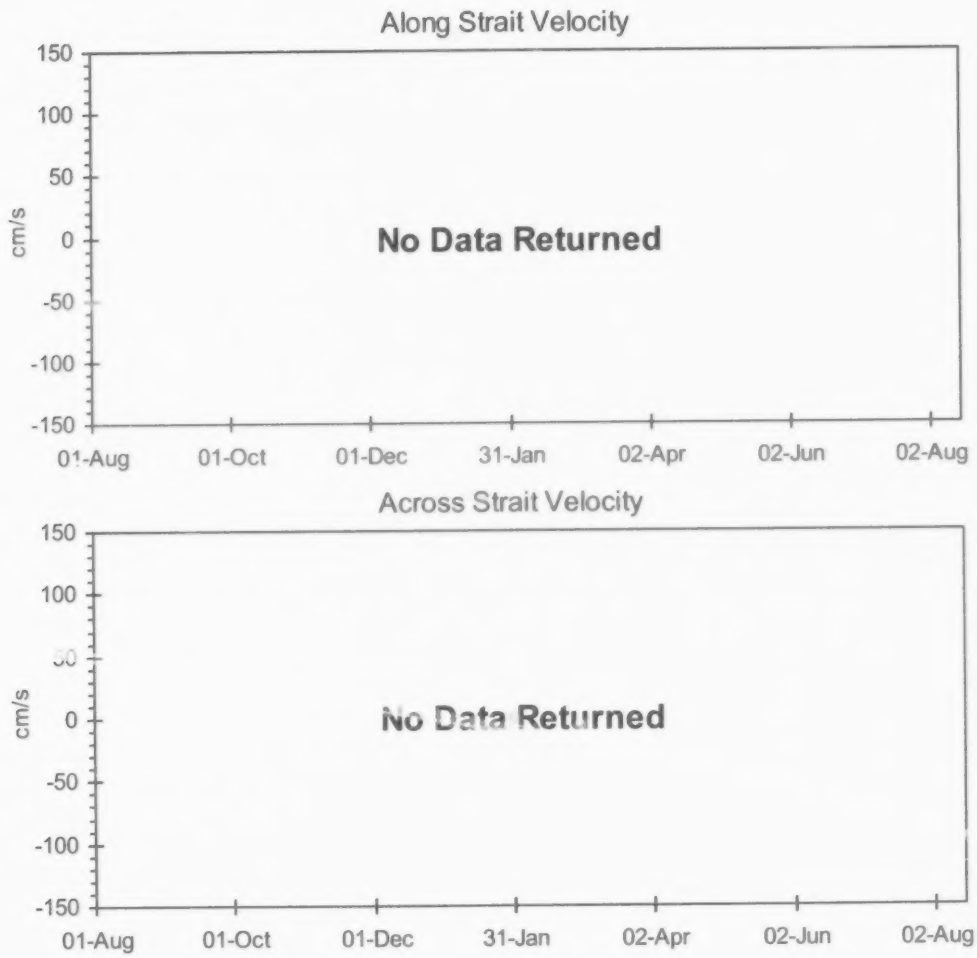


Figure 62 - Ice velocity data, Central Barrow Strait
August 2005 – July 2006

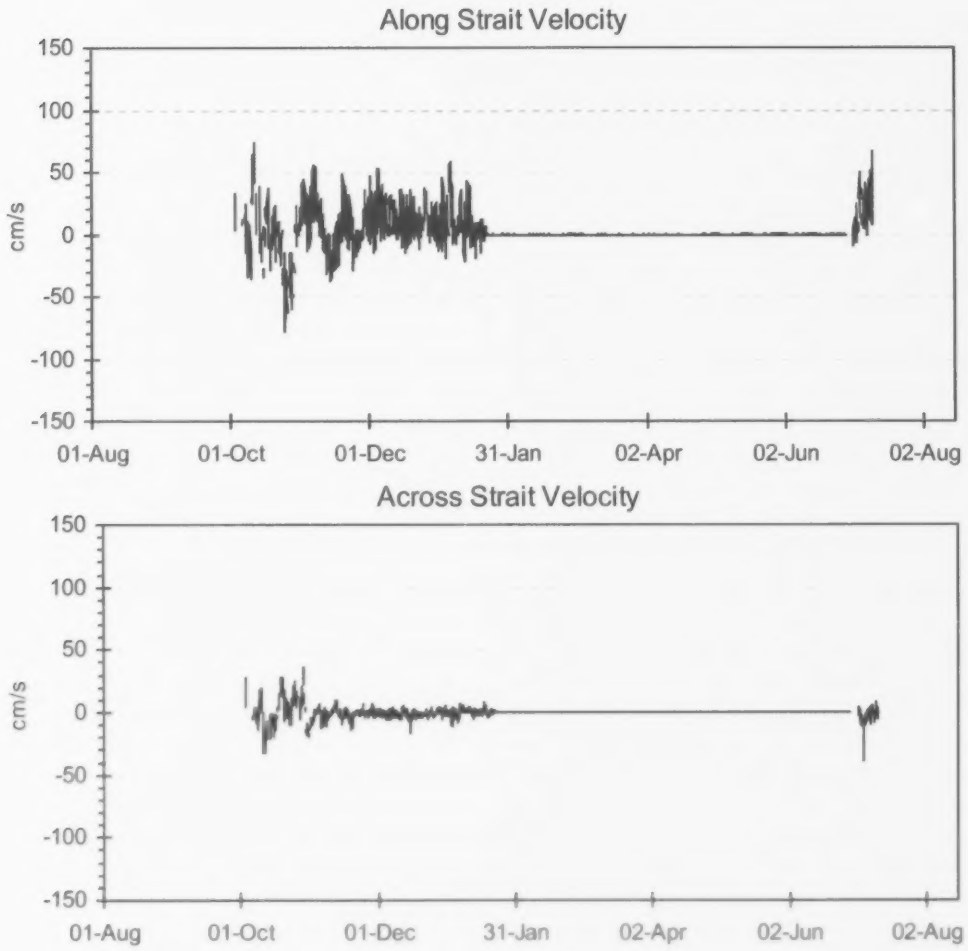


Figure 63 - Ice velocity data, North side of Barrow Strait
August 2005 – July 2006

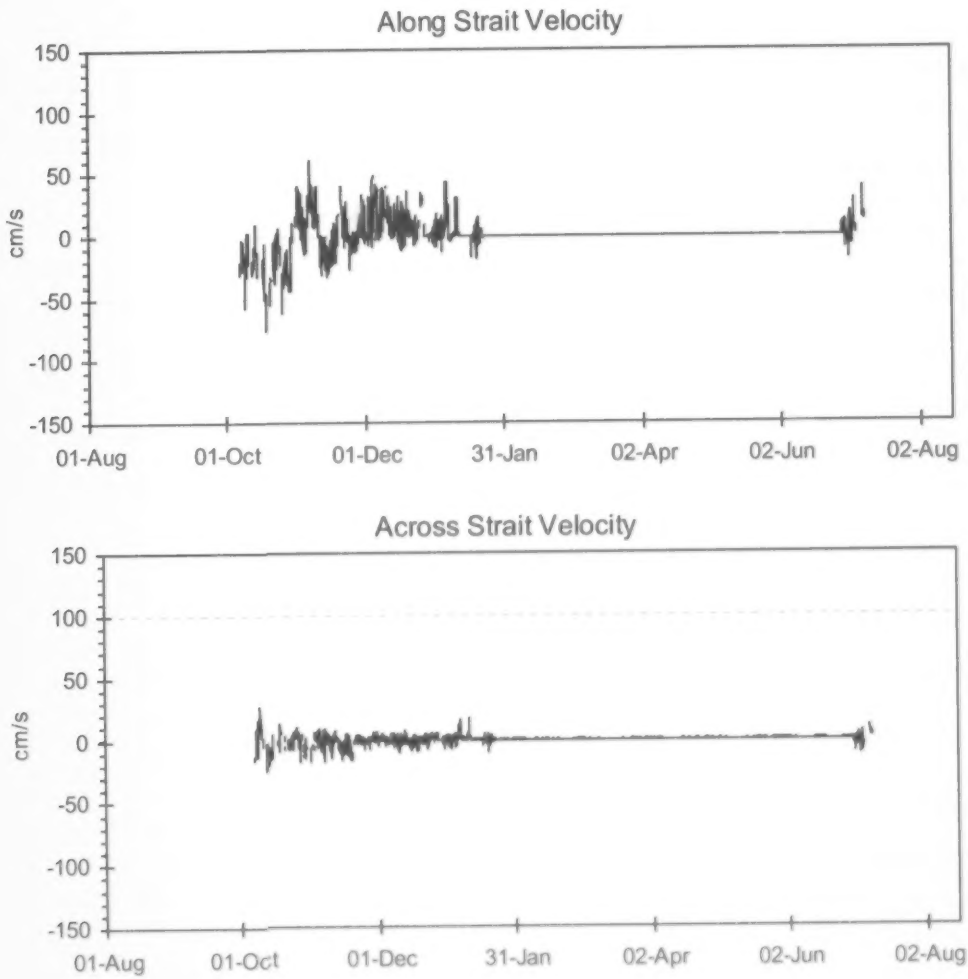


Figure 64: Ice Draft Statistics from Ice Profiling Sonar
South-Central Barrow Strait, August 2005 – July 2006

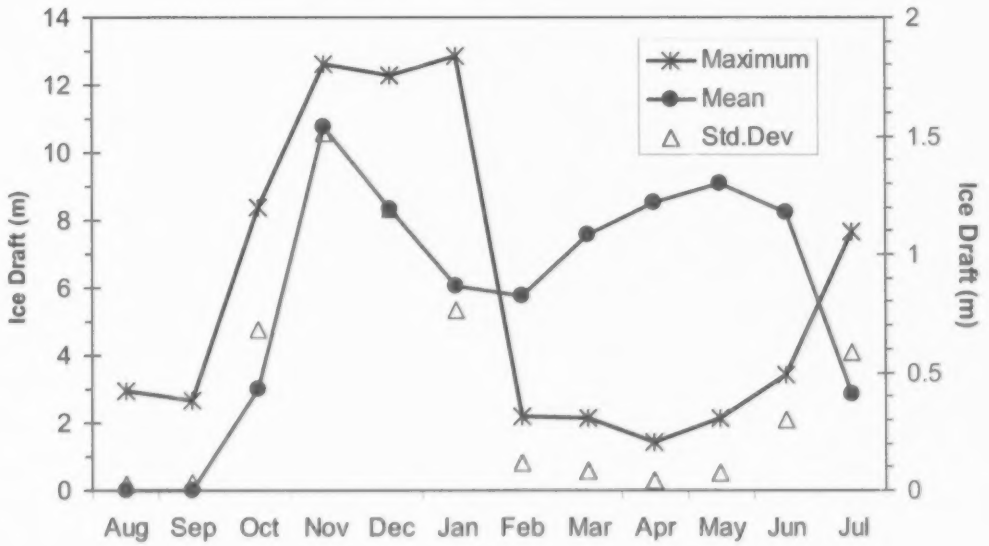


Figure 65: Frequency of Occurrence vs. Ice Draft in meters
South-Central Barrow Strait, August 2005 – July 2006

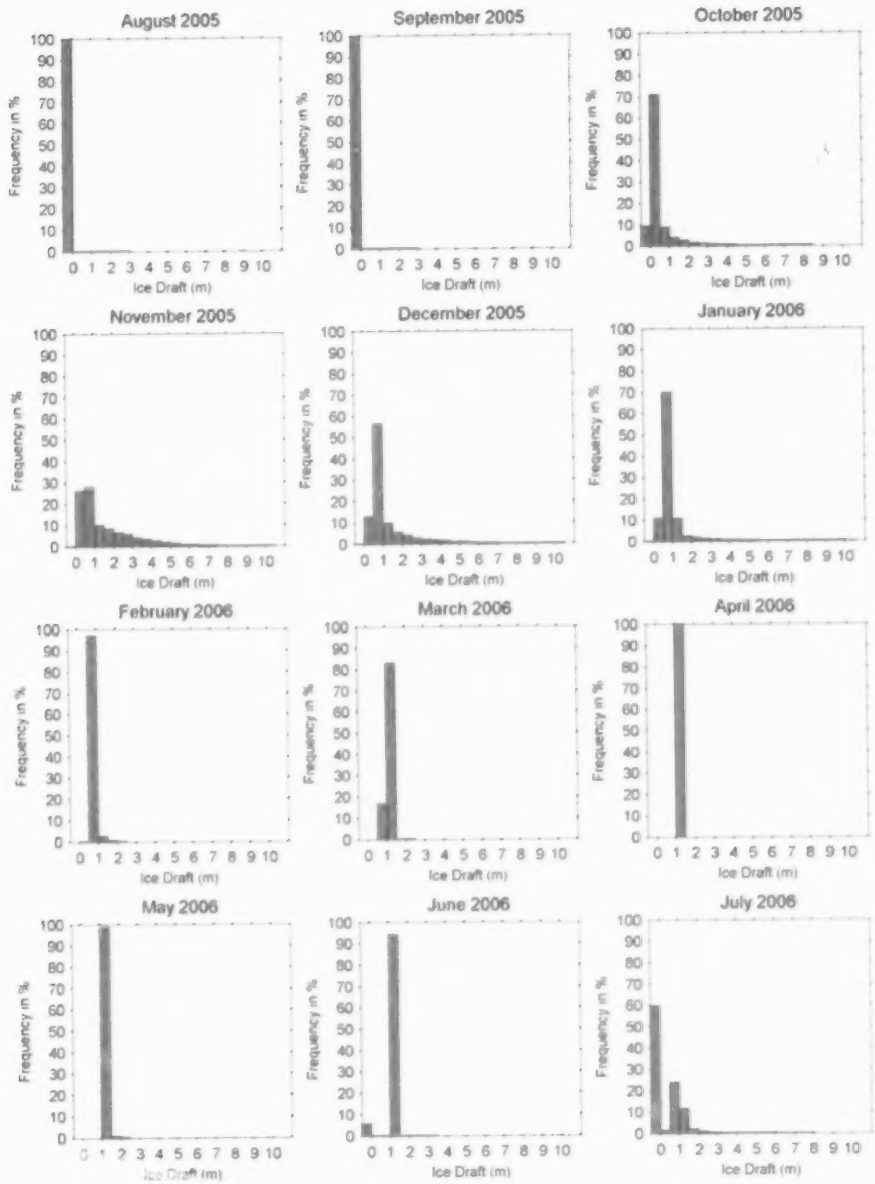


Figure 66 - CTD Station Positions, August 2006

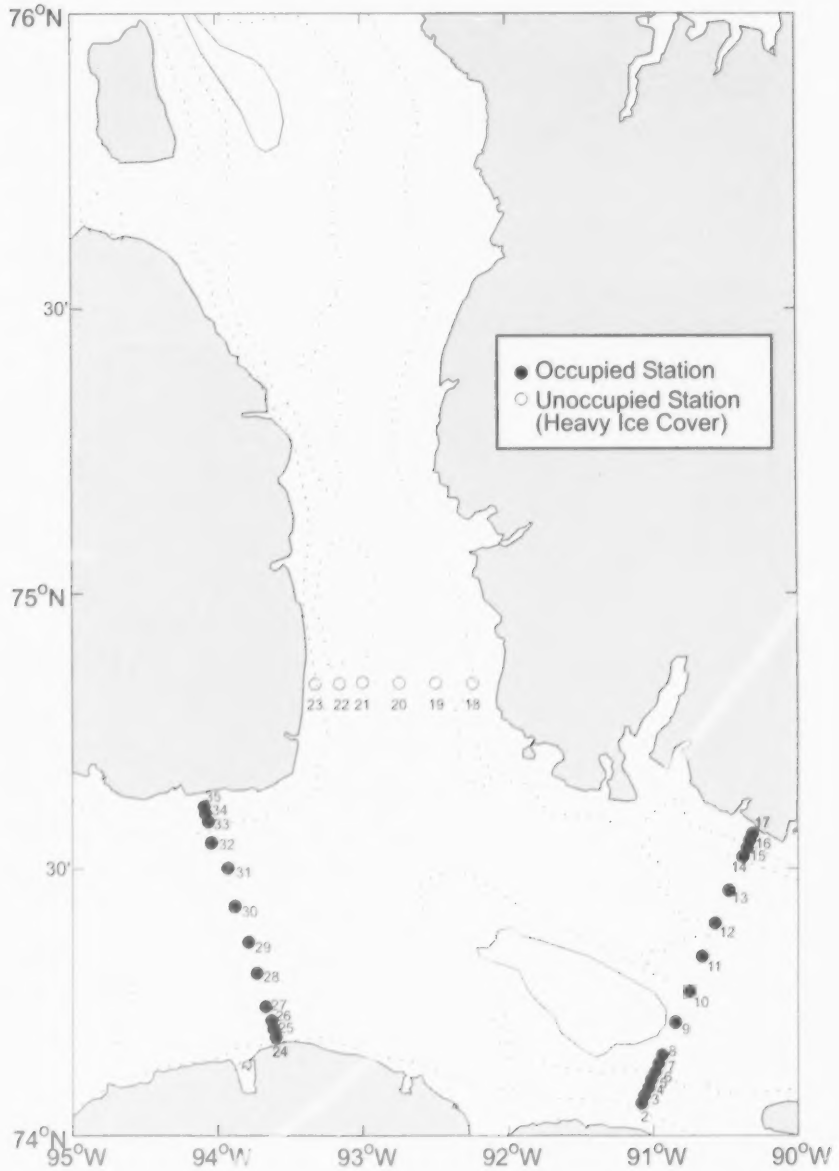


Figure 67 – Eastern Barrow Strait CTD Line, Aug. 5-6, 2006.

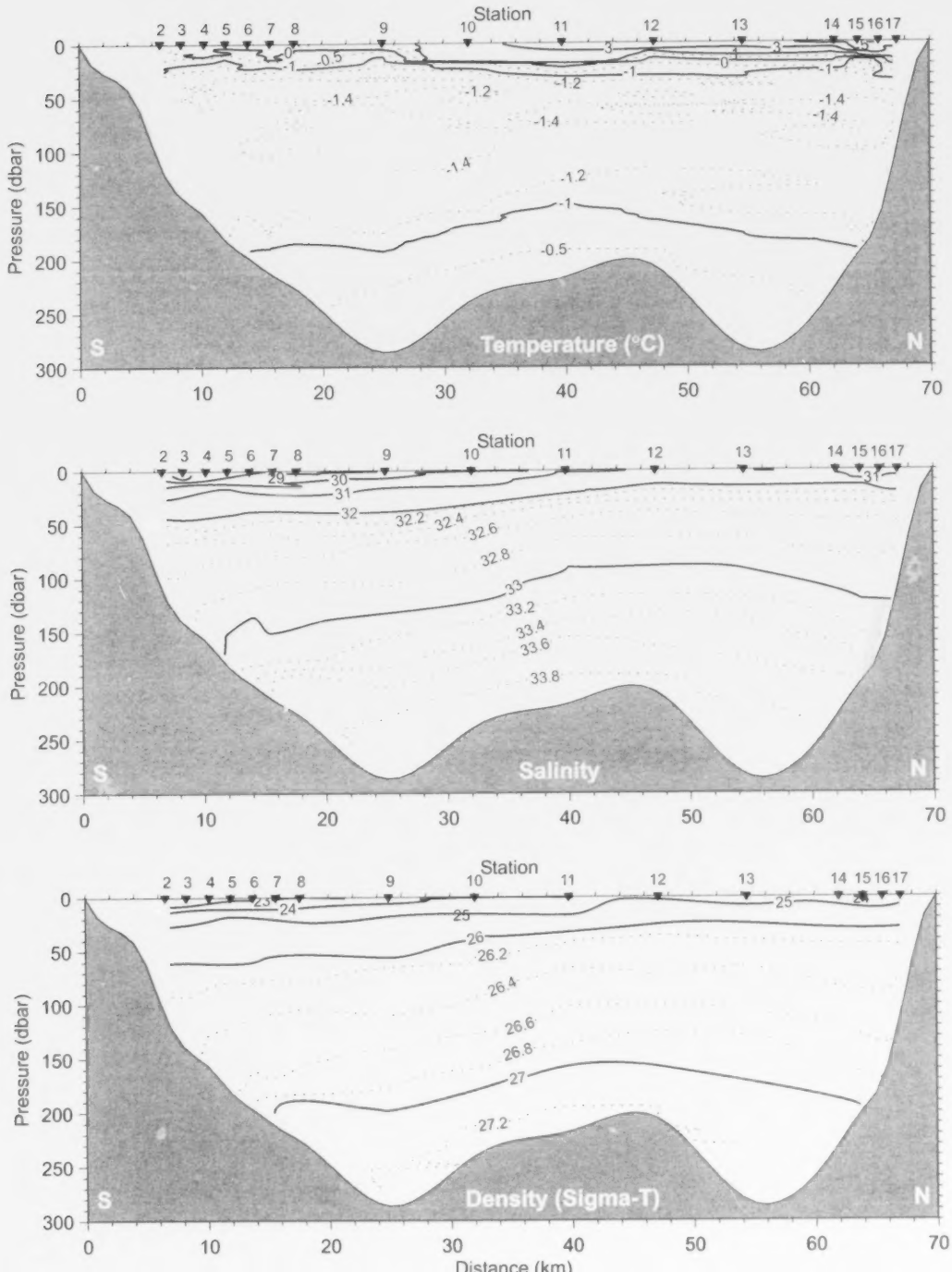


Figure 68 – Western Barrow Strait CTD Line, Aug. 7-9, 2006.

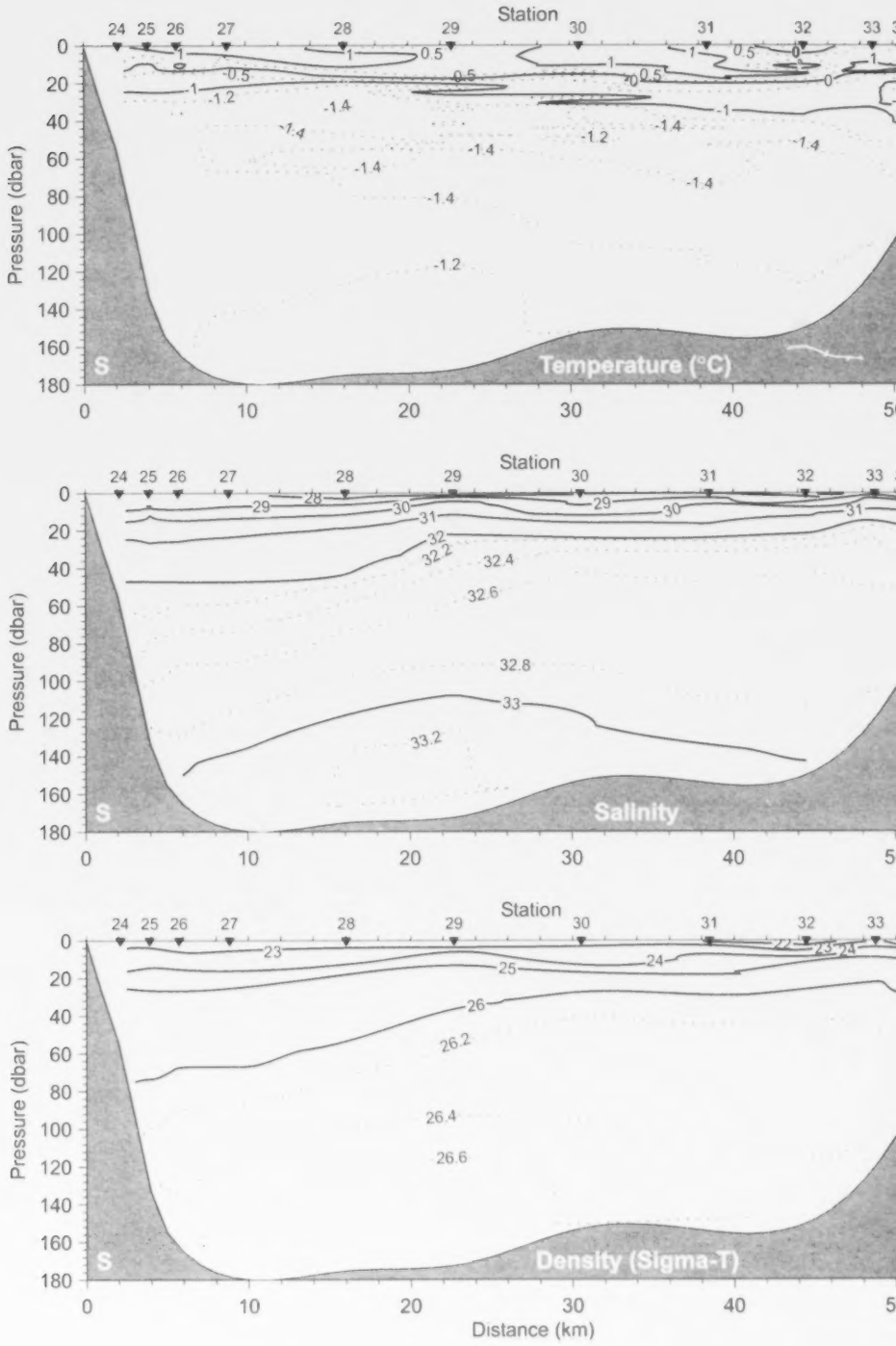
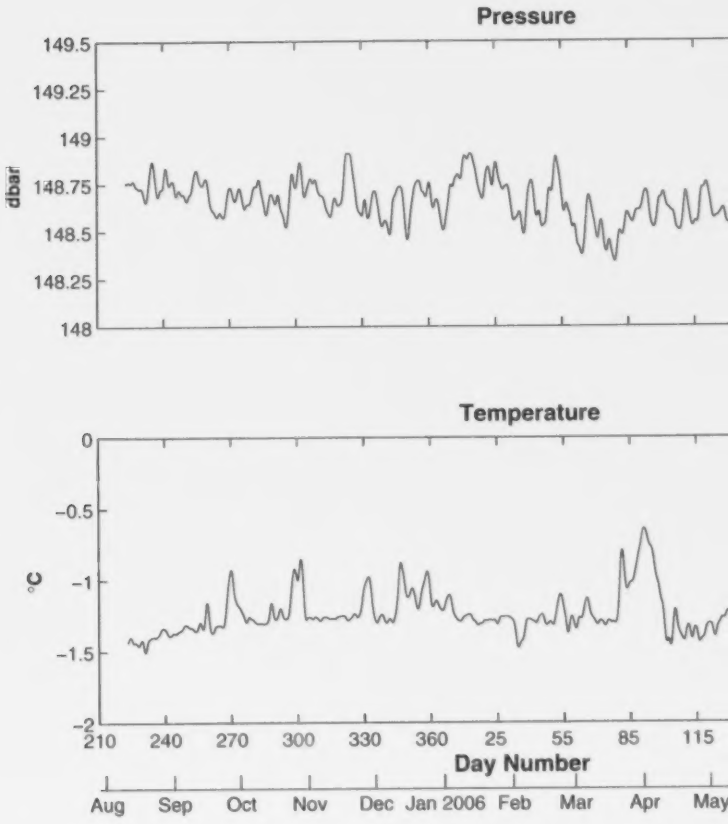
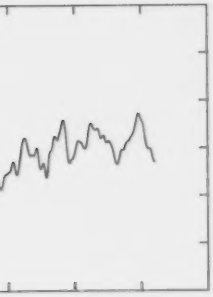


Figure 69: Low-pass filtered Pressure and Te
South Side of Barrow Strait, August 2005 –



nperature.
July 2006



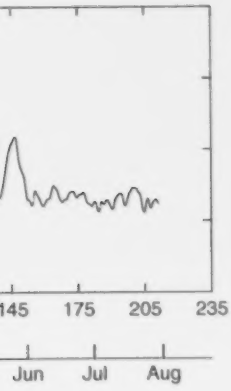
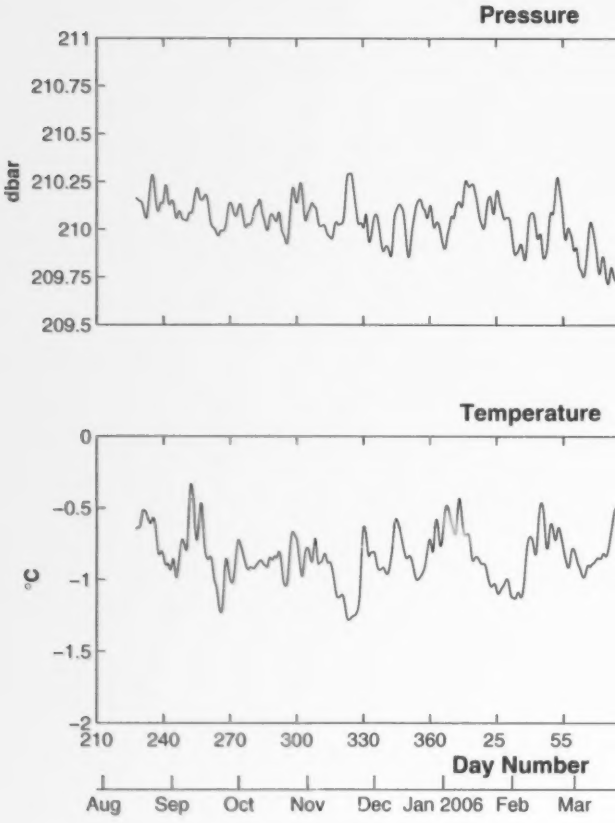
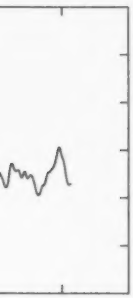
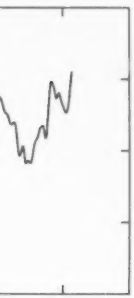


Figure 70: Low-pass filtered Pressu
Central Barrow Strait, August 2



ure.

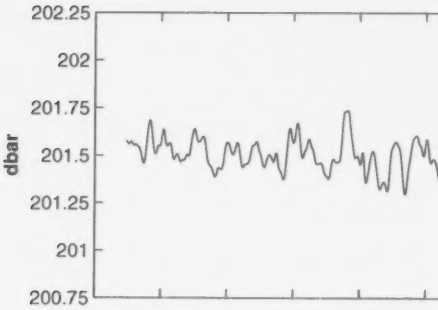


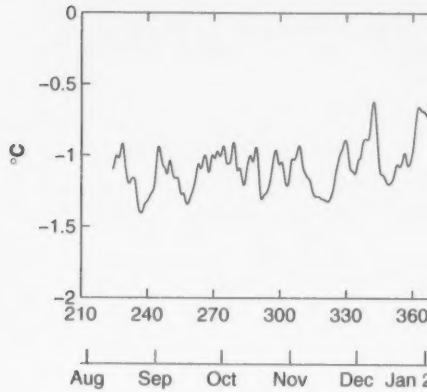


75 205 235

Jul Aug

Figure 71: Low-pass fil
North Side of Barrow





ered Pressure and Temperature.
Strait, August 2005 – July 2006

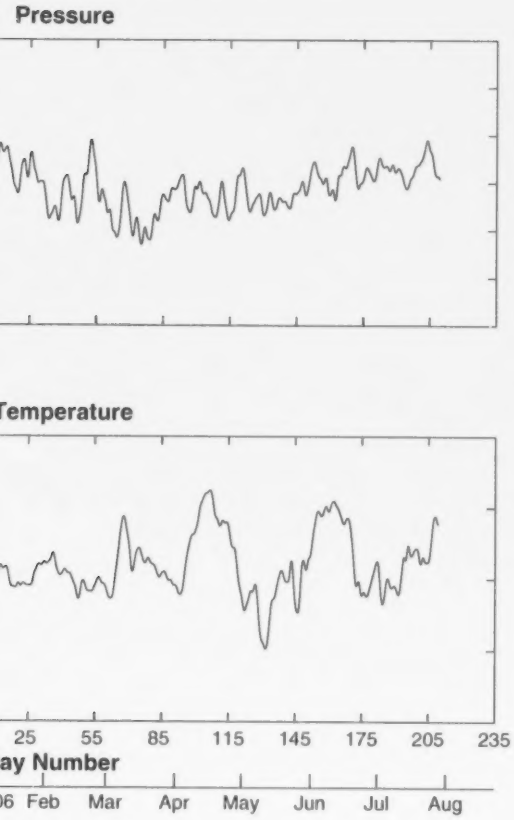


Figure 72: Low-
Western Ba

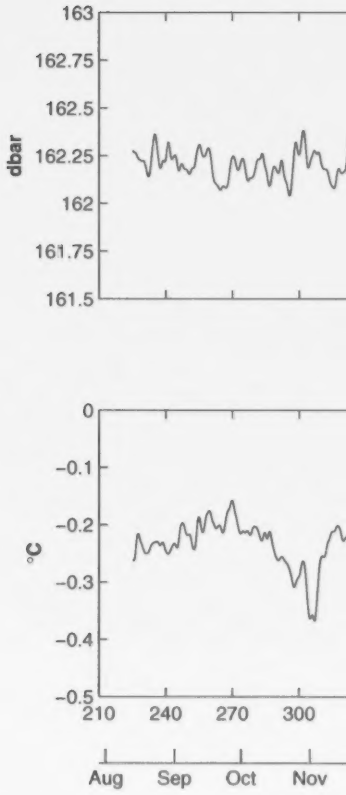


Table 1: Mooring S

South Barrow Strait

BIO Consecutive Mooring Number	Instrument Type†	Moored Depth (m)	Bottom Depth (m)	Latitud (°N)
1569	ICYCLER	50	153	74.084
1570	ADCP	76	147	74.083
1570	MCTD	38	147	74.083
1570	MCTD	78	147	74.083
1570	WLR	147	147	74.083
1571	ADCP	144	148	74.081
1571	MCTD	146	148	74.081

South-Central Barrow Strait

BIO Consecutive Mooring Number	Instrument Type†	Moored Depth (m)	Bottom Depth (m)	Latitud (°N)
1572	LRADCP	250	264	74.195
1573	MCTD	39	269	74.199
1573	MCTD	160	269	74.199
1573	MCTD	264	269	74.199
1574	IPS	56	271	74.194
1574	MCTD	81	271	74.194

†**ADCP**: RDI Workhorse ADCP, **LRADCP**: Long Range ADC

Ta

Central Barrow Strait

BIO Consecutive Mooring Number	Instrument Type†
1575	ADCP
1575	MCTD
1575	MCTD
1575	MCTD
1575	WLR

North Barrow Strait

BIO Consecutive Mooring Number	Instrument Type†
1576	ADCP
1576	MCTD
1576	MCTD
1576	MCTD
1576	WLR

West Barrow Strait

BIO Consecutive Mooring Number	Instrument Type†
1577	WLR

†**ADCP**: RDI Workhorse ADCP

Depth	
Micro Cat	A
38	
78	
146	

Depth	
Micro Cat	A
39	
81	
160	
264	

ıary

/s)	Cross-Strait Velocity (cm/s)			
ax	Avg	SD	Min	Max
.56	10.94	7.19	-9.18	29.76
.37	-1.76	6.76	-24.74	15.41
.52	-1.25	5.84	-17.89	16.28

mary

n/s)	Cross-Strait Velocity (cm/s)			
ax	Avg	SD	Min	Max
7.95	9.11	10.66	-30.42	37.38
5.19	7.76	9.22	-29.12	31.02
7.08	5.08	8.69	-23.26	26.04
9.63	5.06	9.18	-19.72	36.67

Table 6: South Side Barrow Strait, Microcat/ADCP statistical summary
Fall: September 21, 2005 - December 20, 2005

Depth (m)		Temperature (°C)				Salinity (ppt)				Density (Sigma-T)				Along-Strait Velocity (cm/s)				Cross-Strait Velocity (cm/s			
Micro Cat	ADCP	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max
38	38	-1.42	0.20	-1.73	-0.91	31.71	0.31	30.89	32.47	25.50	0.25	24.83	26.11	10.85	18.01	-54.27	70.68	4.28	6.24	-21.87	26.7
78	78	-1.25	0.08	-1.54	-0.66	32.50	0.14	31.93	32.90	26.14	0.11	25.68	26.46	7.16	18.48	-48.50	68.09	-1.31	5.78	-22.78	18.3
146	138	-1.19	0.13	-1.37	-0.70	33.12	0.26	32.61	33.71	26.64	0.21	26.22	27.09	2.02	16.30	-44.60	40.83	-3.06	5.61	-22.97	13.2

Table 7: South-Central Barrow Strait, Microcat/ADCP statistical summary
Fall: September 21, 2005 - December 20, 2005

Depth (m)		Temperature (°C)				Salinity (ppt)				Density (Sigma-T)				Along-Strait Velocity (cm/s)				Cross-Strait Velocity (cm/s			
Micro Cat	ADCP	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max
39	41	-1.43	0.31	-1.74	-0.40	31.84	0.45	31.04	32.67	25.60	0.36	24.96	26.26	4.68	15.02	-42.37	49.17	2.45	7.67	-27.20	29.4
81	81	-1.27	0.09	-1.69	-0.95	32.62	0.17	31.91	32.94	26.23	0.14	25.66	26.50	4.78	15.74	-43.84	54.72	2.80	7.93	-21.50	32.4
160	161	-1.24	0.05	-1.47	-1.04	33.26	0.13	32.90	33.55	26.75	0.10	26.46	26.98	2.75	15.82	-33.14	46.76	1.94	8.14	-22.72	30.6
264	233	-0.60	0.14	-1.18	0.08	33.76	0.07	33.32	34.06	27.13	0.05	26.79	27.35	-1.68	17.47	-53.04	48.20	4.11	7.44	-27.39	32.0

Table 8: Central Barrow Strait, Microcat/ADCP statistical summa
Fall: September 21, 2005 - December 20, 2005

Depth (m)		Temperature (°C)				Salinity (ppt)				Density (Sigma-T)				Along-Strait Velocity (cm			
Micro Cat	ADCP	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	M
38	38	-1.43	0.28	-1.74	-0.15	31.96	0.48	30.97	32.71	25.70	0.39	24.90	26.31	1.83	15.87	-48.78	58
78	70	-1.31	0.09	-1.72	-1.03	32.66	0.17	32.03	33.00	26.27	0.14	25.76	26.55	-0.35	16.18	-41.08	55
157		-1.24	0.03	-1.35	-1.07	33.29	0.11	33.04	33.62	26.78	0.09	26.57	27.04				

Table 9: North Side Barrow Strait, Microcat/ADCP statistical summ
Fall: September 21, 2005 - December 20, 2005

Depth (m)		Temperature (°C)				Salinity (ppt)				Density (Sigma-T)				Along-Strait Velocity (cm			
Micro Cat	ADCP	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	M
39	38	-1.29	0.67	-1.76	1.30	31.86	0.46	30.69	32.58	25.61	0.38	24.68	26.20	-6.00	17.12	-76.31	36
78	70	-1.29	0.11	-1.75	-0.22	32.58	0.22	31.49	33.00	26.20	0.18	25.31	26.54	-4.09	15.93	-57.48	34
158		-1.26	0.06	-1.48	-0.73	33.24	0.19	32.62	33.75	26.74	0.15	26.23	27.13				

Table 10: South Side Barrow Strait, Microcat/ADCI
Winter: December 21, 2005 - March 2

Depth (m)		Temperature (°C)				Salinity (ppt)				Density (Sigma-T)			
Micro Cat	ADCP	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max
38	38	-1.60	0.10	-1.76	-1.29	32.10	0.26	31.14	32.48	25.82	0.21	25.04	26.13
78	78	-1.49	0.16	-1.77	-1.25	32.55	0.07	32.14	32.76	26.19	0.06	25.84	26.35
146	138	-1.24	0.10	-1.54	-0.86	32.93	0.23	32.57	33.62	26.48	0.19	26.20	27.03

Table 11: South-Central Barrow Strait, Microcat/ADC
Winter: December 21, 2005 - March 2

Depth (m)		Temperature (°C)				Salinity (ppt)				Density (Sigma-T)			
Micro Cat	ADCP	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max
39	41	-1.64	0.11	-1.77	-1.32	32.19	0.21	31.49	32.59	25.89	0.17	25.32	26.22
81	81	-1.58	0.18	-1.77	-1.24	32.59	0.06	32.32	32.86	26.22	0.05	26.00	26.44
160	161	-1.23	0.06	-1.52	-0.93	33.08	0.15	32.77	33.61	26.61	0.12	26.36	27.03
264	233	-0.62	0.13	-1.08	-0.29	33.73	0.08	33.28	33.89	27.11	0.06	26.76	27.23

Table 12: Central Barrow St
Winter: Decemb

Depth (m)		Temperature (°C)				Salinity (ppt)			
Micro Cat	ADCP	Avg	SD	Min	Max	Avg	SD	Min	Max
38	38	-1.68	0.09	-1.78	-1.29	32.34	0.16	31.76	32.6
78	70	-1.59	0.17	-1.77	-1.24	32.63	0.07	32.27	32.8
157		-1.19	0.05	-1.42	-0.79	33.19	0.13	32.90	33.6

Table 13: North Side Barrow S
Winter: Decemb

Depth (m)		Temperature (°C)				Salinity (ppt)			
Micro Cat	ADCP	Avg	SD	Min	Max	Avg	SD	Min	Max
39	38	-1.66	0.15	-1.79	-1.25	32.54	0.10	32.19	32.8
78	70	-1.54	0.17	-1.78	-1.24	32.78	0.08	32.61	33.1
158		-1.19	0.08	-1.44	-0.81	33.29	0.14	32.95	33.6

Table 1

Depth (m)		Temperature (°C)		
Micro Cat	ADCP	Avg	SD	Min
38	38	-1.61	0.09	-1.76
78	78	-1.55	0.12	-1.77
146	138	-1.20	0.22	-1.66

Table 15

Depth (m)		Temperature (°C		
Micro Cat	ADCP	Avg	SD	Min
39	41	-1.64	0.07	-1.77
81	81	-1.66	0.10	-1.77
160	161	-1.17	0.11	-1.51
264	233	-0.41	0.10	-0.91

Depth (m	
Micro Cat	AD
38	
78	
157	

Depth (	
Micro Cat	Al
39	
78	
158	

ry

s)	Cross-Strait Velocity (cm/s)			
x	Avg	SD	Min	Max
40	0.81	6.06	-22.21	21.05
90	0.61	5.80	-20.38	23.50

nary

/s)	Cross-Strait Velocity (cm/s)			
ax	Avg	SD	Min	Max
.58	-1.47	4.63	-19.63	12.22
.13	-1.71	3.65	-15.60	9.82

Table 20: Central Barrow Strait, Microcat/ADCP statistical summary
Early Summer: June 21, 2006 – July 29, 2006

Depth (m)		Temperature (°C)				Salinity (ppt)				Density (Sigma-T)				Along-Strait Velocity (cm/s)				Cross-Strait Velocity (cm/s			
Micro Cat	ADCP	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max
38	38	-1.58	0.10	-1.73	-1.06	32.50	0.17	31.71	32.75	26.15	0.14	25.50	26.35	9.15	17.32	-29.27	61.82	-1.37	6.82	-24.72	15.9
78	70	-1.55	0.07	-1.72	-1.32	32.79	0.04	32.64	32.98	26.38	0.04	2	26.53	8.54	17.52	-34.53	65.17	-1.36	7.04	-20.16	18.3
157		-1.16	0.11	-1.34	-0.79	33.41	0.09	33.14	33.67	26.87	0.07	26.65	27.07								

Table 21: North Side Barrow Strait, Microcat/ADCP statistical summary
Early Summer: June 21, 2006 – July 29, 2006

Depth (m)		Temperature (°C)				Salinity (ppt)				Density (Sigma-T)				Along-Strait Velocity (cm/s)				Cross-Strait Velocity (cm/s			
Micro Cat	ADCP	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max
39	38	-1.31	0.41	-1.69	0.59	32.55	0.19	31.49	32.88	26.17	0.17	25.25	26.45	-3.02	13.88	-36.33	27.08	-1.59	5.70	-15.54	19.0
78	70	-1.38	0.05	-1.61	-1.25	32.99	0.10	32.73	33.24	26.53	0.08	26.33	26.73	-2.49	15.88	-38.83	36.43	-2.26	4.43	-18.30	9.1
158		-1.24	0.08	-1.37	-0.71	33.42	0.09	33.18	33.76	26.88	0.07	26.69	27.14								

Table 22: South Side Barrow Strait, Microcat/ADCP statistical sum
Complete Record: August 9, 2005 – July 31, 2006

Depth (m)		Temperature (°C)				Salinity (ppt)				Density (Sigma-T)				Along-Strait Velocity (c			
Micro Cat	ADCP	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	
38	38	-1.50	0.20	-1.76	1.42	31.96	0.32	30.64	32.53	25.70	0.27	24.62	26.17	16.29	17.17	-54.27	
78	78	-1.43	0.16	-1.77	-0.66	32.53	0.11	31.93	32.90	26.17	0.09	25.68	26.46	12.33	17.75	-48.50	
146	138	-1.24	0.15	-1.66	-0.58	32.97	0.27	32.50	33.73	26.52	0.22	26.14	27.11	4.78	14.81	-44.60	

Table 23: South-Central Barrow Strait, Microcat/ADCP statistical su
Complete Record: August 10, 2005 – July 30, 2006

Depth (m)		Temperature (°C)				Salinity (ppt)				Density (Sigma-T)				Along-Strait Velocity (c			
Micro Cat	ADCP	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	
39	41	-1.52	0.24	-1.77	0.30	32.16	0.35	31.04	32.78	25.87	0.28	24.96	26.37	7.98	15.40	-42.37	
81	81	-1.50	0.19	-1.77	-0.95	32.65	0.12	31.91	33.02	26.27	0.10	25.66	26.56	6.81	15.24	-43.84	
160	161	-1.22	0.08	-1.57	-0.78	33.18	0.17	32.75	33.67	26.69	0.14	26.34	27.07	4.40	15.69	-38.87	
264	233	-0.55	0.15	-1.18	0.08	33.76	0.07	33.28	34.06	27.13	0.05	26.76	27.35	-1.66	17.43	-54.77	

Table 24: Central Barrow Strait, Microcat/ADCI
Complete Record: August 10, 2005 – J

Depth (m)		Temperature (°C)				Salinity (ppt)				Density (Sigma-T)			
Micro Cat	ADCP	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Ma
38	38	-1.56	0.22	-1.78	-0.15	32.32	0.36	30.97	32.78	26.00	0.29	24.90	26
78	70	-1.51	0.17	-1.77	-1.03	32.71	0.13	32.03	33.00	26.31	0.10	25.76	26
157		-1.17	0.10	-1.50	-0.69	33.33	0.14	32.90	33.73	26.80	0.11	26.46	27

Table 25: North Barrow Strait, Microcat/ADCP
Complete Record: August 10, 2005 – J

Depth (m)		Temperature (°C)				Salinity (ppt)				Density (Sigma-T)			
Micro Cat	ADCP	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	M
39	38	-1.43	0.55	-1.79	2.38	32.32	0.41	30.65	32.92	25.99	0.34	24.46	26
78	70	-1.42	0.15	-1.78	-0.22	32.81	0.21	31.49	33.36	26.39	0.17	25.31	26
158		-1.22	0.14	-1.59	-0.56	33.35	0.17	32.62	33.81	26.82	0.14	26.23	27

South Side Barr

For Ice Free Per

Depth (m)	Major Am (cm/
10	8.3
14	8.0
18	8.2
22	7.9
26	7.7
30	7.6
34	7.3
38	6.6
42	6.9
46	7.3
50	7.2
54	6.9
58	6.7
62	6.7
66	7.1
70	7.7
74	9.5
78	9.8
82	9.6
86	9.3
90	9.4
94	9.2
98	8.9
102	8.9
106	8.7
110	8.4
114	8.4
118	8.4
122	8.9
126	9.6
130	10.0
134	10.3
138	10.5

able 26 - Tidal Constants for K1 Constituent

w Strait

od (Aug. 9, 2005 – Oct. 02, 2005):

tude	Minor Amplitude (cm/s)	Orientation (degrees cc from East)	Greenwich Phase (degrees)
	-0.62	170	2
	-0.67	174	2
	-0.54	175	1
	-0.72	173	355
	-0.97	167	352
	-1.18	165	347
	-1.03	168	346
	-0.99	172	353
	-0.83	176	358
	-0.70	180	357
	-0.55	179	356
	-0.02	176	352
	-0.43	170	347
	-0.63	168	347
	-0.46	168	346
	-0.18	164	344
	0.67	144	340
	0.79	146	340
	0.88	147	338
	1.13	149	337
	1.50	152	337
	1.97	154	337
	2.59	157	337
	2.93	158	337
	3.05	158	337
	3.20	157	336
	3.30	159	337
	3.22	159	336
	3.00	157	333
	2.70	154	331
	2.52	154	331
	2.51	156	333
	2.78	159	333

South

For Sol

Depth (m)
10
14
18
22
26
30
34
38
42
46
50
54
58
62
66
70
74
78
82
86
90
94
98
102
106
110
114
118
122
126
130
134
138

al Constants for K1 Constituent (continued)

ait

an. 21, 2006 – Jun. 28, 2006):

Minor Amplitude (cm/s)	Orientation (degrees cc from East)	Greenwich Phase (degrees)
1.91	201	6
2.21	190	357
2.23	182	351
2.22	175	346
2.12	170	341
2.11	167	337
1.96	166	335
1.94	165	334
2.05	164	332
2.33	163	332
2.47	163	332
2.48	164	330
2.36	164	330
2.29	163	329
2.28	163	328
2.37	162	327
1.88	146	326
1.91	146	326
1.98	146	325
2.11	147	324
2.15	147	323
2.22	147	323
2.32	148	323
2.52	148	323
2.66	149	322
2.86	149	322
2.97	149	322
3.00	150	321
2.99	150	320
3.06	150	319
3.09	150	318
3.13	152	317
3.00	154	314

Table 26 - Tidal Constants for K1 Constituent (continued)

South Central Barrow Strait

For Ice Free Period (Aug. 10, 2005 – Oct. 02, 2005):

Depth (m)	Major Amplitude (cm/s)	Minor Amplitude (cm/s)	Orientation (degrees cc from East)	Greenwich Phase (degrees)
25	8.65	-1.31	160	358
33	9.52	-0.52	157	352
41	10.29	-0.44	154	356
49	11.16	-1.10	158	356
57	12.01	-1.02	154	358
65	11.93	-0.95	152	356
73	12.11	-0.58	151	357
81	12.03	-0.15	153	0
89	11.76	-0.22	154	0
97	11.90	-0.25	152	0
105	12.06	-0.03	152	1
113	12.13	-0.13	153	1
121	11.81	0.04	154	359
129	11.72	0.15	156	0
137	11.98	0.20	157	1
145	12.46	-0.43	158	4
153	12.56	0.03	159	3
161	12.82	0.07	161	1
169	12.83	-0.45	159	0
177	13.59	-0.77	159	0
185	14.22	-1.05	164	358
193	14.31	-0.96	165	356
201	14.93	-1.62	164	355
209	16.03	-1.83	162	356
217	17.12	-1.58	162	355
225	16.89	-1.79	160	356
233	17.62	-2.14	161	359

Table 26 - Tidal Constants for K1 Constituent (continued)

uth Central Barrow Strait

r Solid Ice Period (Jan. 21, 2006 – Jun. 28, 2006):

epth m)	Major Amplitude (cm/s)	Minor Amplitude (cm/s)	Orientation (degrees cc from East)	Greenwich Phase (degrees)
25	11.46	-1.04	170	359
33	11.46	-1.21	167	359
41	11.46	-1.33	167	358
49	11.46	-1.55	166	358
57	11.46	-1.47	165	359
65	11.61	-1.35	165	359
73	11.72	-1.39	165	0
81	11.75	-1.44	165	0
89	11.88	-1.45	165	0
97	11.95	-1.57	165	0
05	12.12	-1.47	164	0
13	12.25	-1.47	164	0
21	12.69	-1.61	164	1
29	13.12	-1.72	164	0
37	13.51	-1.81	164	1
45	13.96	-1.99	165	1
53	14.22	-2.12	165	1
61	14.53	-2.04	164	2
69	15.12	-2.00	164	2
77	15.50	-2.06	165	2
85	15.85	-2.07	165	3
93	16.27	-2.30	166	3
01	16.70	-2.44	165	2
09	17.38	-2.69	165	2
17	17.68	-2.72	164	4
25	16.92	-2.66	163	5
33	16.55	-2.60	163	7

Table 26 - Tidal Constants for K1 Constituent (continued)

Central Barrow Strait

For Ice Free Period (Aug. 10, 2005 – Oct. 06, 2005):

Depth (m)	Major Amplitude (cm/s)	Minor Amplitude (cm/s)	Orientation (degrees cc from East)	Greenwich Phase (degrees)
10	11.45	-1.46	162	356
14	12.01	-1.82	165	351
18	12.71	-2.15	166	352
22	12.56	-2.17	166	353
26	12.90	-1.52	165	358
30	12.81	-1.39	165	1
34	12.75	-1.77	164	2
38	12.89	-2.03	163	2
42	13.31	-2.08	164	4
46	13.62	-1.70	164	4
50	13.31	-1.52	164	4
54	13.17	-1.63	163	4
58	13.40	-1.53	164	4
62	13.28	-1.69	164	6
66	13.40	-1.79	163	7
70	13.40	-1.83	163	7

For Solid Ice Period (Jan. 21, 2006 – Jun. 28, 2006):

Depth (m)	Major Amplitude (cm/s)	Minor Amplitude (cm/s)	Orientation (degrees cc from East)	Greenwich Phase (degrees)
10	10.72	-1.30	178	4
14	11.49	-1.68	173	1
18	11.66	-1.75	168	358
22	11.62	-1.95	166	356
26	11.66	-2.13	165	356
30	12.02	-2.27	164	357
34	12.14	-2.39	163	358
38	12.07	-2.43	163	358
42	12.18	-2.41	163	358
46	12.47	-2.52	163	358
50	12.44	-2.45	163	359
54	12.44	-2.38	163	359
58	12.46	-2.44	163	359
62	12.48	-2.39	163	359
66	12.42	-2.42	163	359
70	12.36	-2.39	163	360

Table 26 - Tidal Constants for K1 Constituent (continued)

North Side Barrow Strait

For Ice Free Period (Aug. 10, 2005 – Oct. 06, 2005):

Depth (m)	Major Amplitude (cm/s)	Minor Amplitude (cm/s)	Orientation (degrees cc from East)	Greenwich Phase (degrees)
10	8.69	-0.54	185	354
14	8.16	-0.67	184	343
18	8.12	0.21	181	334
22	8.45	0.99	174	331
26	8.35	0.68	173	327
30	8.54	0.78	174	328
34	8.91	0.81	173	331
38	9.34	0.83	170	329
42	9.35	0.48	172	327
46	9.70	0.51	170	321
50	10.32	1.18	168	316
54	10.55	1.29	168	316
58	10.48	1.01	168	316
62	10.93	0.94	169	316
66	11.36	0.85	170	317
70	11.87	0.60	168	316

For Solid Ice Period (Jan. 21, 2006 – Jun. 28, 2006):

Depth (m)	Major Amplitude (cm/s)	Minor Amplitude (cm/s)	Orientation (degrees cc from East)	Greenwich Phase (degrees)
10	5.72	0.95	183	298
14	8.34	1.12	177	300
18	9.35	0.74	170	299
22	10.01	0.36	165	298
26	10.29	0.09	162	297
30	10.34	-0.02	161	297
34	10.27	0.05	160	298
38	9.99	0.08	161	300
42	9.91	0.16	161	301
46	10.42	0.27	162	302
50	10.55	0.33	162	304
54	10.70	0.21	162	305
58	10.84	0.14	163	307
62	11.10	0.08	163	308
66	11.28	0.03	163	310
70	11.39	-0.09	163	311

Table 27 - Tidal Constants for M2 Constitue

South Side Barrow Strait

For Ice Free Period (Aug. 09, 2005 – Oct. 02, 2005):

Depth (m)	Major Amplitude (cm/s)	Minor Amplitude (cm/s)	Orientation (degrees cc from East)
10	7.69	-1.57	177
14	7.34	-1.16	171
18	7.52	-0.80	169
22	7.81	-0.67	168
26	7.96	-0.34	167
30	8.16	-0.20	166
34	8.33	-0.28	165
38	8.58	-0.19	165
42	8.50	-0.14	164
46	8.41	-0.18	164
50	8.76	-0.46	166
54	9.09	-0.86	168
58	9.14	-1.27	169
62	9.05	-1.52	169
66	9.04	-1.67	169
70	9.29	-1.80	169
74	9.74	-1.68	146
78	10.06	-1.87	146
82	10.29	-2.12	146
86	10.47	-2.14	146
90	10.57	-2.08	146
94	10.67	-2.12	147
98	10.75	-2.01	148
102	10.69	-1.67	148
106	10.42	-1.31	149
110	10.22	-1.03	150
114	10.08	-0.81	151
118	9.86	-0.79	152
122	9.68	-0.93	155
126	9.72	-0.94	160
130	9.77	-0.64	165
134	9.80	-0.32	169
138	9.60	0.03	174

Table 27 - Tidal Constants for M2 Constituent (continued)

South Central Barrow Strait

For Ice Free Period (Aug. 10, 2005 – Oct. 02, 2005):

Depth (m)	Major Amplitude (cm/s)	Minor Amplitude (cm/s)	Orientation (degrees cc from East)	Greenwich Phase (degrees)
25	10.24	1.31	174	189
33	10.68	0.92	173	189
41	10.50	1.15	175	191
49	10.25	1.46	177	194
57	10.01	1.19	181	200
65	9.84	1.54	183	204
73	9.15	1.82	185	203
81	9.00	1.79	186	205
89	8.87	1.77	184	205
97	8.44	1.72	184	205
105	8.36	2.09	181	201
113	7.66	2.47	181	199
121	7.07	2.86	180	198
129	7.09	2.83	181	201
137	6.96	2.79	183	205
145	7.25	2.26	185	207
153	7.37	2.17	188	208
161	7.76	1.88	193	210
169	8.15	1.55	195	214
177	8.24	1.76	197	216
185	8.29	1.47	198	216
193	8.40	1.12	199	217
201	8.27	0.62	200	219
209	8.19	0.51	201	223
217	8.04	0.74	205	226
225	7.13	0.76	209	230
233	6.35	1.36	220	236

Table 27 - Tidal Constants for M2 Constituent (continued)

South Central Barrow Strait

For Solid Ice Period (Jan. 21, 2006 – Jun. 28, 2006):

Depth (m)	Major Amplitude (cm/s)	Minor Amplitude (cm/s)	Orientation (degrees cc from East)	Greenwic (degr
25	7.07	1.43	197	20
33	8.95	0.09	191	20
41	9.65	-0.62	188	20
49	9.78	-0.71	186	20
57	9.71	-0.73	185	20
65	9.58	-0.63	184	20
73	9.38	-0.59	184	20
81	9.19	-0.49	184	20
89	9.18	-0.40	185	20
97	9.07	-0.44	185	20
105	8.97	-0.33	186	20
113	8.71	-0.24	186	20
121	8.64	-0.09	186	20
129	8.30	0.21	185	20
137	7.93	0.49	186	20
145	7.70	0.88	186	20
153	7.25	1.22	186	20
161	7.16	1.43	184	20
169	7.18	1.66	183	19
177	7.30	1.69	184	20
185	7.45	1.61	186	20
193	7.51	1.47	188	20
201	7.32	1.27	191	20
209	7.23	1.04	195	20
217	7.21	0.86	197	21
225	6.46	0.93	199	21
233	5.66	1.41	205	21

Table 27 - Tidal Constants for M2 Constituent (c

Central Barrow Strait

For Ice Free Period (Aug. 10, 2005 – Oct. 06, 2005):

Depth (m)	Major Amplitude (cm/s)	Minor Amplitude (cm/s)	Orientation (degrees cc from East)
10	8.91	-0.40	163
14	9.47	-1.22	160
18	10.35	-1.78	157
22	10.61	-2.15	158
26	10.38	-2.42	160
30	10.16	-2.26	163
34	10.03	-1.89	162
38	10.01	-1.98	161
42	10.37	-2.17	160
46	10.62	-2.15	161
50	10.67	-1.85	162
54	10.34	-1.98	163
58	10.23	-2.01	163
62	10.06	-1.97	164
66	10.09	-1.93	164
70	10.31	-1.90	165

For Solid Ice Period (Jan. 21, 2006 – Jun. 28, 2006):

Depth (m)	Major Amplitude (cm/s)	Minor Amplitude (cm/s)	Orientation (degrees cc from East
10	4.26	3.05	249
14	4.13	3.53	230
18	4.86	2.83	179
22	6.70	1.28	171
26	8.26	-0.37	169
30	9.80	-1.66	166
34	10.83	-2.69	165
38	11.26	-3.23	165
42	11.39	-3.47	164
46	11.71	-3.60	164
50	11.71	-3.60	164
54	11.69	-3.58	164
58	11.60	-3.51	165
62	11.55	-3.46	165
66	11.42	-3.40	164
70	11.22	-3.36	165

ntinued)

Greenwich Phase (degrees)
195
187
186
189
194
198
196
194
195
196
197
197
198
199
199
200

Greenwich Phase (degrees)
271
252
204
198
196
194
193
192
192
192
192
192
192
192
193
193

Table 27 - Tidal Constants for M2 Cons

North Side Barrow Strait

For Ice Free Period (Aug. 10, 2005 – Oct. 06, 200

Depth (m)	Major Amplitude (cm/s)	Minor Amplitude (cm/s)	Orien (degrees c
10	9.50	0.96	1
14	9.72	0.83	1
18	9.73	0.63	1
22	9.45	0.63	1
26	9.10	0.41	1
30	9.05	0.13	1
34	9.30	0.07	1
38	9.60	0.24	1
42	9.66	-0.06	1
46	10.03	-0.45	1
50	10.26	-0.51	1
54	9.90	-0.46	1
58	9.44	-0.36	1
62	9.33	-0.25	1
66	9.07	-0.18	1
70	9.04	-0.10	1

For Solid Ice period (Jan. 21, 2006 – Jun. 28, 200

Depth (m)	Major Amplitude (cm/s)	Minor Amplitude (cm/s)	Orien (degrees c
10	3.69	2.62	1
14	6.08	3.27	1
18	7.32	2.60	1
22	8.62	1.44	1
26	9.80	0.24	1
30	10.74	-0.69	1
34	11.34	-1.27	1
38	11.04	-1.35	1
42	10.88	-1.18	1
46	11.08	-1.06	1
50	10.92	-1.06	1
54	10.79	-1.02	1
58	10.68	-0.94	1
62	10.53	-0.75	1
66	10.43	-0.57	1
70	10.15	-0.37	1

ed)

nwich Phase degrees)
177
175
174
177
181
181
180
181
185
185
184
183
183
182
182
182

nwich Phase degrees)
165
167
173
177
179
180
180
180
179
178
177
176
176
176
175
175

Table 28 - Tidal Cons

South Side Barrow Strait

For Ice Free Period (Aug. 09, 2005 –

Depth (m)	Major Amplitude (cm/s)	Minor Amplitude (cm/s)
10	3.71	0.53
14	3.99	0.06
18	3.78	0.35
22	3.38	0.70
26	3.52	0.49
30	3.48	0.33
34	3.47	0.48
38	3.60	0.81
42	3.72	0.89
46	3.74	0.94
50	3.50	0.95
54	3.30	0.73
58	3.24	0.61
62	3.37	0.62
66	3.32	0.53
70	3.28	0.41
74	3.64	-0.11
78	3.59	-0.15
82	3.49	-0.20
86	3.51	0.01
90	3.29	0.21
94	3.24	0.34
98	3.16	0.46
102	3.12	0.63
106	3.16	0.88
110	3.16	0.98
114	3.04	1.17
118	2.90	1.45
122	2.88	1.56
126	2.96	1.77
130	3.16	1.87
134	3.35	1.93
138	3.47	2.04

nts for O1 Constituent

ct. 02, 2005):

Orientation (degrees cc from East)	Greenwich Phase (degrees)
180	324
180	316
178	311
180	314
174	310
167	307
164	305
164	306
164	305
166	304
164	301
160	295
163	289
167	285
169	286
171	284
151	280
150	278
149	277
152	279
151	280
150	281
151	280
153	282
152	278
153	275
153	275
157	276
158	277
159	278
157	273
158	271
158	267

Table 28 - Tidal Co

South Side Barrow Strait

For Solid Ice Period (Jan. 2

Depth (m)	Major Amplitude (cm/s)	Mino
10	2.58	
14	2.81	
18	2.87	
22	2.90	
26	2.94	
30	3.05	
34	3.20	
38	3.00	
42	2.91	
46	3.08	
50	3.12	
54	3.22	
58	3.19	
62	3.14	
66	3.21	
70	3.31	
74	3.86	
78	3.95	
82	3.99	
86	4.03	
90	4.05	
94	4.08	
98	4.17	
102	4.20	
106	4.23	
110	4.26	
114	4.27	
118	4.30	
122	4.36	
126	4.41	
130	4.43	
134	4.46	
138	4.40	

Constituent (continued)

, 2006):

Orientation ees cc from East)	Greenwich Phase (degrees)
183	296
181	291
174	290
168	285
164	283
164	283
164	280
162	278
163	278
162	278
161	278
161	277
161	276
160	275
158	272
155	270
144	271
144	270
145	270
146	269
146	270
148	271
150	273
151	273
152	273
154	274
156	274
157	275
158	275
158	276
158	275
158	273
161	270

Table 2

South Central Ba

For Ice Free Peri

Depth (m)	Major Ampl (cm/s)
25	5.90
33	6.43
41	6.51
49	6.87
57	7.10
65	7.32
73	7.47
81	7.39
89	7.44
97	7.29
105	7.54
113	7.55
121	7.62
129	7.61
137	7.74
145	7.81
153	7.97
161	8.11
169	8.50
177	8.94
185	9.02
193	9.44
201	9.88
209	10.38
217	10.77
225	10.60
233	10.85

- Tidal Constants for O1 Constituent (continued)

row Strait

d (Aug. 10, 2005 – Oct. 02, 2005):

ude	Minor Amplitude (cm/s)	Orientation (degrees cc from East)	Greenwich Phase (degrees)
	0.51	156	299
	0.57	158	301
	0.55	157	300
	0.31	159	300
	0.38	156	301
	0.31	158	303
	0.53	161	303
	0.53	163	303
	0.85	164	303
	1.02	164	303
	1.23	164	304
	1.11	163	303
	0.86	163	304
	0.85	163	304
	0.99	163	303
	0.86	162	303
	0.85	164	305
	0.72	165	305
	0.56	165	304
	0.50	165	304
	0.24	166	302
	0.11	166	302
	-0.02	165	302
	-0.19	164	302
	-0.24	163	303
	-0.38	161	305
	-0.23	162	308

South C

For Soli

Depth (m)
25
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169
177
185
193
201
209
217
225
233

l Constants for O1 Constituent (continued)

trait

n. 21, 2006 to Jun. 28, 2006):

Minor Amplitude (cm/s)	Orientation (degrees cc from East)	Greenwich Phase (degrees)
0.01	168	302
-0.09	165	300
-0.25	163	300
-0.18	162	299
-0.18	162	300
-0.25	162	300
-0.26	163	300
-0.29	162	301
-0.22	163	301
-0.28	163	301
-0.23	163	301
-0.27	163	302
-0.27	162	301
-0.24	162	301
-0.22	161	303
-0.04	162	304
-0.16	162	304
-0.33	161	305
0.04	163	307
0.28	165	307
0.39	164	306
0.31	163	303
0.18	162	303
-0.11	161	301
-0.13	162	302
-0.17	161	301
-0.32	162	303

Table 28 - Tidal Constants for O1 Constituent (continued)

Central Barrow Strait

For Ice Free Period (Aug. 10, 2005 – Oct. 06, 2005):

Depth (m)	Major Amplitude (cm/s)	Minor Amplitude (cm/s)	Orientation (degrees cc from East)	Greenwich Phase (degrees)
10	5.82	-0.30	163	303
14	5.76	-0.36	162	301
18	5.72	-0.72	160	301
22	5.79	-0.92	160	302
26	5.66	-0.62	161	303
30	5.57	-0.47	163	304
34	5.68	-0.53	163	305
38	5.71	-0.54	162	308
42	5.90	-0.58	162	310
46	6.05	-0.64	163	310
50	6.03	-0.62	161	311
54	5.97	-0.59	161	309
58	5.99	-0.64	162	310
62	6.06	-0.51	161	311
66	5.99	-0.47	162	312
70	5.93	-0.57	160	313

For Solid Ice Period (Jan. 21, 2006 – Jun. 28, 2006):

Depth (m)	Major Amplitude (cm/s)	Minor Amplitude (cm/s)	Orientation (degrees cc from East)	Greenwich Phase (degrees)
10	4.63	-0.07	169	312
14	5.13	-0.46	166	311
18	5.30	-0.65	164	309
22	5.30	-0.86	161	306
26	5.22	-0.88	160	304
30	5.33	-0.82	159	304
34	5.45	-0.90	157	305
38	5.31	-0.90	157	306
42	5.23	-0.85	158	305
46	5.46	-1.03	157	306
50	5.62	-1.07	158	306
54	5.57	-1.06	158	306
58	5.56	-1.10	158	306
62	5.57	-1.12	159	306
66	5.61	-1.16	158	307
70	5.57	-1.10	158	308

Table 28 - Tidal Constants for O1 Constituent (continued)

h Side Barrow Strait

Ice Free Period (Aug. 10, 2005 – Oct. 06, 2005):

th	Major Amplitude (cm/s)	Minor Amplitude (cm/s)	Orientation (degrees cc from East)	Greenwich Phase (degrees)
	4.21	-0.62	177	291
	4.39	-0.34	177	291
	4.43	-0.32	179	295
	4.43	-0.51	183	291
	4.44	-0.25	187	286
	4.46	-0.13	186	283
	4.62	-0.36	180	280
	4.76	-0.42	178	275
	4.87	-0.26	176	275
	4.71	-0.15	173	276
	4.56	0.19	175	275
	4.64	0.08	176	272
	4.79	0.23	175	267
	4.96	0.19	174	264
	5.03	0.07	171	263
	5.12	-0.09	170	260

Solid Ice Period (Jan. 21, 2006 – Jun. 28, 2006):

h	Major Amplitude (cm/s)	Minor Amplitude (cm/s)	Orientation (degrees cc from East)	Greenwich Phase (degrees)
	2.74	0.60	180	247
	3.60	0.65	176	249
	3.96	0.61	171	250
	4.18	0.38	167	248
	4.39	0.25	165	248
	4.39	0.17	165	249
	4.42	0.14	167	251
	4.30	0.20	169	254
	4.26	0.25	170	254
	4.35	0.24	170	256
	4.44	0.10	169	258
	4.50	0.06	169	258
	4.54	0.01	167	259
	4.64	0.01	167	261
	4.74	0.00	167	261
	4.72	-0.08	167	260

Table 29 - Tidal Constants for P1 Constituent

South Side Barrow Strait

For Ice Free Period (Aug. 09, 2005 – Oct. 02, 2005):

Depth (m)	Major Amplitude (cm/s)	Minor Amplitude (cm/s)	Orientation (degrees cc from East)	Greenwich Phase (degrees)
10	3.69	-1.64	151	2
14	2.85	-1.60	164	351
18	2.41	-1.01	167	355
22	2.79	-1.36	166	341
26	3.00	-1.89	174	325
30	3.76	-1.89	179	318
34	3.58	-1.29	187	315
38	2.09	-0.80	208	300
42	1.37	-0.22	244	301
46	1.69	-0.28	256	329
50	1.88	-0.14	246	334
54	1.82	-0.19	219	327
58	2.22	-0.90	224	303
62	2.44	-1.09	239	291
66	2.06	-1.49	230	300
70	2.35	-1.83	154	6
74	3.28	-0.88	144	358
78	3.56	-0.79	148	1
82	3.25	-0.81	153	356
86	2.97	-0.30	163	354
90	3.00	-0.07	170	1
94	2.79	0.19	179	11
98	2.93	0.77	191	17
102	3.13	0.87	192	20
106	3.15	1.02	195	23
110	2.90	0.92	196	27
114	3.17	0.81	197	31
118	3.20	0.77	197	29
122	3.45	0.61	195	18
126	3.88	0.36	175	10
130	4.28	0.03	172	14
134	4.77	-0.21	174	22
138	5.30	-0.05	179	26

Table 29 - Tidal Constants for P1 Constituent (continued)

South Side Barrow Strait

For Solid Ice Period (Jan. 21, 2006 – Jun. 28, 2006):

Depth (m)	Major Amplitude (cm/s)	Minor Amplitude (cm/s)	Orientation (degrees cc from East)	Greenwich Phase (degrees)
10	3.17	0.43	196	15
14	2.94	0.19	194	7
18	2.91	0.07	193	356
22	2.90	0.14	194	356
26	2.55	0.48	190	352
30	2.42	0.72	183	346
34	2.30	0.74	176	340
38	2.15	0.81	170	334
42	2.24	0.85	170	333
46	2.22	0.95	170	329
50	2.28	0.93	167	327
54	2.39	0.89	169	326
58	2.37	0.77	168	326
62	2.38	0.83	167	327
66	2.32	0.91	167	328
70	2.11	1.00	170	329
74	2.73	0.84	135	320
78	2.86	0.90	135	320
82	2.93	0.99	136	320
86	2.94	1.14	136	319
90	2.83	1.18	137	317
94	2.80	1.27	138	317
98	2.78	1.32	139	318
102	2.74	1.23	141	319
106	2.65	1.20	140	316
110	2.61	1.23	140	316
114	2.50	1.28	140	316
118	2.50	1.34	142	317
122	2.51	1.33	140	315
126	2.43	1.39	140	314
130	2.26	1.26	145	317
134	2.30	1.10	148	317
138	2.27	0.98	149	315

Table 29 - Tidal Constants for P1 Constituent (cont

South Central Barrow Strait

For Ice Free Period (Aug. 10, 2005 – Oct. 02, 2005):

Depth (m)	Major Amplitude (cm/s)	Minor Amplitude (cm/s)	Orientation (degrees cc from East)
25	3.90	-0.92	137
33	5.29	-1.09	135
41	4.69	-0.92	128
49	4.64	-0.13	142
57	4.81	-0.69	141
65	5.18	-1.39	139
73	5.48	-1.24	136
81	4.97	-0.73	131
89	4.65	-0.46	132
97	4.83	-0.79	130
105	4.32	-0.27	128
113	4.35	-0.02	132
121	4.84	-0.12	133
129	4.82	-0.09	130
137	4.62	0.16	129
145	3.99	0.46	133
153	4.27	0.42	126
161	4.76	0.61	131
169	5.16	-0.15	138
177	5.46	-0.41	142
185	5.78	0.32	148
193	6.36	0.25	147
201	6.31	-0.17	151
209	6.94	-0.31	148
217	7.84	-0.06	146
225	8.09	-0.31	146
233	8.21	-0.15	152

Table 29 - Tidal Constants for P1 Constituent (continued)

Central Barrow Strait

For Ice Free Period (Aug. 10, 2005 – Oct. 06, 2005):

Depth (m)	Major Amplitude (cm/s)	Minor Amplitude (cm/s)	Orientation (degrees cc from East)	Greenwich Phase (degrees)
10	4.18	-0.45	155	340
14	5.07	-0.68	162	335
18	5.97	-1.05	165	337
22	5.81	-0.87	165	338
26	5.27	-0.37	158	346
30	4.91	-0.02	158	351
34	4.53	-0.52	156	353
38	4.60	-0.91	154	354
42	4.74	-0.88	154	0
46	4.77	-0.46	154	3
50	4.77	-0.36	154	0
54	4.70	-0.63	153	1
58	4.67	-0.39	155	4
62	4.53	-0.45	154	5
66	4.63	-0.65	153	9
70	4.42	-0.67	152	11

For Solid Ice Period (Jan. 21, 2006 – Jun. 28, 2006):

Depth (m)	Major Amplitude (cm/s)	Minor Amplitude (cm/s)	Orientation (degrees cc from East)	Greenwich Phase (degrees)
10	4.79	-1.09	173	3
14	5.21	-1.28	170	1
18	4.99	-1.37	165	358
22	4.62	-1.10	165	355
26	4.30	-0.95	165	354
30	4.13	-0.98	162	355
34	4.02	-1.01	160	355
38	4.05	-1.12	158	355
42	4.20	-1.08	159	356
46	4.14	-1.12	160	355
50	4.12	-1.04	160	356
54	4.15	-0.93	160	358
58	4.12	-0.95	161	358
62	4.12	-0.97	161	357
66	4.09	-0.96	161	357
70	3.96	-0.94	160	357

Table 29 - Tidal Constants for P1 Constituent (continued)

North Side Barrow Strait

For Ice Free Period (Aug. 10, 2005 – Oct. 06, 2005):

Depth (m)	Major Amplitude (cm/s)	Minor Amplitude (cm/s)	Orientation (degrees cc from East)	Greenwich (degre
10	2.16	0.00	228	11
14	2.41	0.52	210	328
18	3.28	0.62	188	307
22	3.38	0.38	171	300
26	3.28	0.25	172	287
30	3.18	0.44	165	281
34	2.74	0.81	158	277
38	2.47	0.70	161	284
42	2.25	1.03	167	282
46	2.93	0.81	166	280
50	3.62	0.89	155	283
54	3.66	0.77	152	286
58	3.41	0.75	159	285
62	3.46	0.81	162	287
66	3.44	1.03	164	293
70	3.95	0.72	167	299

For Solid Ice Period (Jan. 21, 2006 – Jun. 28, 2006):

Depth (m)	Major Amplitude (cm/s)	Minor Amplitude (cm/s)	Orientation (degrees cc from East)	Greenwich (degree
10	2.38	0.75	180	300
14	3.02	0.77	175	300
18	3.37	0.52	166	297
22	3.57	0.25	163	297
26	3.71	0.06	163	294
30	3.71	-0.08	162	291
34	3.57	-0.01	161	291
38	3.53	0.22	161	294
42	3.60	0.43	162	296
46	3.67	0.41	165	298
50	3.67	0.39	166	302
54	3.65	0.32	165	303
58	3.59	0.26	167	307
62	3.59	0.28	167	310
66	3.61	0.26	167	312
70	3.70	0.15	167	315

Table 30 - Tidal Constants for S2 Constitue

South Side Barrow Strait

For Ice Free Period (Aug. 9, 2005 – Oct. 02, 2005):

Depth (m)	Major Amplitude (cm/s)	Minor Amplitude (cm/s)	Orientation (degrees cc from East)
10	5.08	-2.28	183
14	4.85	-1.67	183
18	4.73	-1.05	173
22	4.85	-0.82	168
26	4.68	-0.64	162
30	4.62	-0.84	158
34	4.69	-0.68	158
38	4.56	-0.18	159
42	4.27	-0.05	160
46	3.84	0.09	164
50	3.71	0.53	167
54	3.75	0.76	168
58	4.14	0.94	170
62	4.34	0.93	167
66	4.69	0.95	167
70	4.57	0.83	168
74	4.75	-0.04	148
78	4.86	-0.15	150
82	4.62	-0.35	152
86	4.66	-0.41	155
90	4.83	-0.44	158
94	4.83	-0.58	158
98	4.98	-0.59	156
102	5.07	-0.64	154
106	5.06	-0.74	152
110	5.06	-0.55	150
114	4.99	-0.41	150
118	4.98	-0.31	152
122	4.87	-0.27	153
126	4.73	-0.15	155
130	4.75	-0.20	156
134	4.81	-0.35	159
138	4.68	-0.54	165

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Greenwich Phase (degrees)
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Table 30 - Tidal Constants for S2 Consti

South Side Barrow Strait

For Solid ice Period (Jan. 21, 2006 – Jun. 28, 2006

Depth (m)	Major Amplitude (cm/s)	Minor Amplitude (cm/s)	Orienta (degrees cc fr
10	1.63	0.82	225
14	1.42	1.04	157
18	1.77	0.79	164
22	2.37	0.29	167
26	3.12	-0.17	174
30	3.59	-0.53	178
34	3.86	-0.67	179
38	3.87	-0.90	179
42	3.87	-1.13	180
46	4.21	-1.19	177
50	4.05	-1.04	173
54	3.98	-0.94	172
58	3.99	-0.84	171
62	3.91	-0.76	171
66	3.91	-0.87	170
70	3.87	-0.85	169
74	3.99	-0.98	154
78	4.05	-1.01	155
82	4.17	-1.03	154
86	4.18	-1.16	153
90	4.19	-1.15	154
94	4.10	-1.11	153
98	4.04	-1.13	153
102	4.00	-1.06	153
106	3.88	-1.05	154
110	3.77	-1.00	155
114	3.71	-0.81	157
118	3.57	-0.69	159
122	3.42	-0.56	160
126	3.36	-0.42	163
130	3.32	-0.29	167
134	3.22	-0.13	172
138	3.13	0.12	180

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ich Phase grees)
133
233
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Table 30 - Tidal Constants fo

South Central Barrow Strait

For Ice Free Period (Aug. 10, 2005 – O

Depth (m)	Major Amplitude (cm/s)	Minor Amplitude (cm/s)
25	6.74	-1.72
33	6.43	-1.40
41	5.93	-0.91
49	5.60	-0.65
57	5.40	-0.81
65	5.40	-0.80
73	5.34	-0.76
81	5.25	-0.67
89	5.17	-0.61
97	5.06	-0.71
105	5.05	-0.88
113	5.22	-0.92
121	5.02	-0.65
129	4.75	-0.73
137	4.51	-0.56
145	4.46	-0.64
153	4.55	-0.51
161	4.29	-0.23
169	3.90	-0.16
177	3.59	0.08
185	3.12	0.21
193	2.85	0.35
201	2.64	0.03
209	2.89	-0.17
217	3.60	-0.78
225	3.72	-1.30
233	3.51	-1.99

S2 Constituent (continued)

t. 02, 2005):

Orientation (degrees cc from East)	Greenwich Phase (degrees)
205	242
212	247
213	256
217	257
220	261
222	265
226	262
224	263
225	261
224	260
223	260
223	259
220	259
226	262
226	263
226	266
229	268
233	266
236	263
237	264
237	266
232	265
221	255
217	251
217	245
221	247
225	249

Table 30 - Tidal Con

South Central Barrow Strait

For Solid Ice Period (Jan. 21,

Depth (m)	Major Amplitude (cm/s)	Minor A (c
25	2.46	
33	2.97	
41	3.29	-(
49	3.34	
57	3.42	
65	3.33	
73	3.34	
81	3.32	
89	3.39	
97	3.55	
105	3.53	-(
113	3.58	
121	3.64	-(
129	3.72	-(
137	3.74	
145	3.73	-(
153	3.63	
161	3.46	
169	3.15	
177	2.94	
185	2.84	
193	2.69	
201	2.58	
209	2.43	
217	2.35	
225	1.93	
233	1.61	

onstituent (continued)

, 2006):

Orientation (ees cc from East)	Greenwich Phase (degrees)
196	261
190	258
190	260
190	258
188	258
187	256
187	255
187	254
184	254
186	254
186	255
185	255
183	253
181	252
181	249
180	247
181	246
182	248
184	251
184	248
182	245
181	245
183	247
187	246
186	250
190	253
193	253

Table 3

Central Barrow S

For Ice Free Peri

Depth (m)	Major Ampl (cm/s)
10	10.52
14	9.92
18	8.47
22	6.95
26	6.06
30	5.87
34	5.66
38	5.48
42	5.44
46	5.30
50	5.14
54	5.21
58	5.26
62	5.34
66	5.33
70	5.26

For Solid Ice Per

Depth (m)	Major Ampl (cm/s)
10	2.10
14	1.63
18	2.32
22	3.40
26	4.11
30	4.64
34	4.79
38	4.83
42	4.82
46	5.02
50	4.91
54	4.86
58	4.75
62	4.75
66	4.78
70	4.75

- Tidal Constants for S2 Constituent (continued)

ait

l (Aug. 10, 2005 – Oct. 06, 2005):

de	Minor Amplitude (cm/s)	Orientation (degrees cc from East)	Greenwich Phase (degrees)
	-6.38	162	233
	-5.72	168	237
	-4.23	176	243
	-2.93	176	250
	-1.88	176	253
	-1.70	174	253
	-1.57	172	250
	-1.56	169	248
	-1.45	169	248
	-1.35	170	248
	-1.16	170	249
	-1.07	170	250
	-1.13	170	250
	-1.19	171	251
	-1.10	171	252
	-1.07	172	252

d (Jan. 21, 2006 – Jun. 28, 2006):

ude	Minor Amplitude (cm/s)	Orientation (degrees cc from East)	Greenwich Phase (degrees)
	0.61	65	146
	1.19	77	155
	0.53	160	237
	-0.30	161	239
	-0.79	162	238
	-1.29	165	235
	-1.59	169	239
	-1.68	172	241
	-1.79	172	243
	-1.83	173	245
	-1.72	174	245
	-1.55	173	245
	-1.44	173	244
	-1.48	173	245
	-1.48	173	245
	-1.41	173	246

North Si

For Ice F

Depth (m)	
10	
14	
18	
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54	
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62	
66	
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For Soli

Depth (m)	
10	
14	
18	
22	
26	
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34	
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46	
50	
54	
58	
62	
66	
70	

al Constants for S2 Constituent (continued)

it

g. 10, 2005 – Oct. 06, 2005):

Minor Amplitude (cm/s)	Orientation (degrees cc from East)	Greenwich Phase (degrees)
-1.32	173	232
-0.98	180	232
-0.89	180	233
-0.57	181	233
-0.53	182	230
-0.35	183	230
-0.45	184	232
-0.32	180	235
-0.13	177	236
-0.10	177	235
0.06	178	233
0.09	175	233
0.04	176	232
-0.05	177	233
0.12	177	232
0.09	175	230

n. 21, 2006 – Jun. 28, 2006):

Minor Amplitude (cm/s)	Orientation (degrees cc from East)	Greenwich Phase (degrees)
1.03	179	212
1.44	177	220
1.20	181	225
0.90	181	230
0.58	182	234
0.19	182	232
-0.19	180	230
-0.25	177	228
-0.16	174	226
-0.17	172	222
-0.19	172	221
-0.07	171	219
-0.12	171	218
-0.05	171	220
-0.12	171	219
-0.16	171	220

Ice Draft (m)	Aug
Open Water	
0.0-0.5	
0.5-1.0	
1.0-1.5	
1.5-2.0	
2.0-2.5	
2.5-3.0	
3.0-3.5	
3.5-4.0	
4.0-4.5	
4.5-5.0	
5.0-5.5	
5.5-6.0	
6.0-6.5	
6.5-7.0	
7.0-7.5	
7.5-8.0	
8.0-8.5	
8.5-9.0	
9.0-9.5	
9.5-10.0	
>=10.0	

Month

2006			
April	May	June	July
0.00	0.00	5.73	59.86
0.00	0.00	0.04	1.23
0.00	0.00	0.03	23.88
100.00	98.99	94.06	11.54
0.00	0.65	0.12	1.98
0.00	0.37	0.02	0.75
0.00	0.00	0.00	0.33
0.00	0.00	0.00	0.20
0.00	0.00	0.00	0.10
0.00	0.00	0.00	0.04
0.00	0.00	0.00	0.02
0.00	0.00	0.00	0.01
0.00	0.00	0.00	0.01
0.00	0.00	0.00	0.01
0.00	0.00	0.00	0.01
0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00

Table 36: West Barrow Strait, Water Level Recorder Statistical Summary

	Temperature (°C)				Depth (m)			
Season	**Avg**	**SD**	**Min**	**Max**	**Avg**	**SD**	**Min**	**Max**
Late Summer	-0.22	0.03	-0.29	-0.15	160.49	0.41	159.51	161.5
Fall	-0.24	0.05	-0.39	-0.12	160.44	0.40	159.47	161.5
Winter	-0.23	0.03	-0.36	-0.15	160.41	0.42	159.38	161.5
Spring	-0.21	0.08	-0.36	0.02	160.39	0.40	159.54	161.4
Early Summer	-0.23	0.04	-0.39	-0.15	160.53	0.40	159.58	161.3
Year	-0.23	0.05	-0.39	0.02	160.44	0.41	159.38	161.5